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THE TRANSPORT PROBLEM.

DURING last week several important events took place bearing directly upon the transport problem, both as it affects London and as it affects the whole country. It is gratifying to observe that this question is now receiving the attention that is its due, but which it never could gain until it was forced upon the notice of the public by touching their most sensitive spot—their pockets. We have previously remarked that the average man is reluctant to pay for transport service; hence the demand of the London Railway Companies for power to increase their charges, backed up with proofs that otherwise they cannot continue solvent, has brought the facts home to him with unpleasant emphasis. As Sir Eric Geddes said in his presidential address to the new-born Institute of Transport last week: "The State is faced with this: Under pre-war conditions of revenue, no one single transportation agency can continue to exist. And yet their healthy existence and development are vital to the State. And at long last the public are coming to understand this." "The interests of the community and the interests of the transport agencies are one."

Sir Eric dealt with the subject of transport in relation to the State, and showed that State control was indispensable though he avoided any direct discussion of the policy of State ownership; State control, however, necessarily involves a national guarantee that private capital shall receive a fair return, while it demands that the transport service shall be improved to the utmost, and that devastating disputes with Labour shall not occur. In order to provide the information required for these purposes, he laid great stress on the necessity of securing accurate comparative statistics and data from the operating companies, and foreshadowed legislation to that end. One passage in his address seems rather ominous—namely, that in which he invites the new Institute to act as "umpire" in the battle between alternating and direct current, in connection with the impending "great extensions of the application of electricity to railway traction." From past experience, we know only too well the harmful results of a "battle" of this kind, and we sincerely trust that every effort will be made to arrive at a definite decision without embarking on a protracted controversy.

We fear that the appointment of a Transport Advisory Committee last week to consider whether and what regulations should be made for the electrification of railways in respect of interchange of traffic, uniformity of system, &c., bears only too close a resemblance to the inauguration of the contemplated battle. These Committees! We know them well. They possess unlimited powers and possibilities of delaying progress; they meet once a month, and take a year to collect evidence, and another year to make up their minds—and then their advice is not adopted. We must make an exception, however, in the case of the Advisory Committee on London Traffic, which published its

Report also last week. This Committee, under the guidance of a man of "push and go," has accomplished its task with comparative celerity, and has arrived at no uncertain decision. Its recommendations are admirable—above all, that which calls for the appointment of a supreme traffic authority for London, consisting of three members, giving their whole time to their work, and invested with the necessary powers by the Ministry of Transport. These are the fundamental conditions which must be fulfilled to secure results, and to secure them quickly. Voluntary unpaid Committees, of which we have so many that hardly anyone has escaped being put on one or other, are ineffective and futile so far as administration is concerned; if control is necessary, let it be in the hands of a whole-time body of the least possible number of men, with full authority. Then we shall get things done. There is nc work so inefficient as work that is not paid for. The exceptions only prove this rule.

The need for a supreme authority for London traffic has been so often pointed out by Commissions of Inquiry, and we have so consistently endorsed the demand, that we need say little further on this point; we hope that Sir Eric Geddes, who has already shown a willingness to be guided by advice, will lose no time before he calls this authority into being.

In the meantime, the case of the London Electric Railways brooks no delay; it cannot wait for the Authority, and Parliament is, therefore, dealing with it. We are pleased to see that the House of Commons has bowed before the facts, and that the opposition of the London M.P.'s to the Bill has been withdrawn. As Mr. J. H. Thomas most rightly pointed out, here was a case where employers and employed were in absolute concord—and promptly people declared that it was an unholy alliance against the public! The prospect before the Whitley Councils would be poor indeed if this were the general attitude towards their conciliation schemes.

Another Committee?

Yes! Another Committee—as though we had not had enough already! And what do we want to know now? Answer: How to increase production! To help us to increase our production of manufactured goods, let us then first increase our production of Government-appointed Committees. The exact terms of reference shall be these: "To consider and advise as to the best means of securing the greatest possible production consistent with the permanent well-being of industry and of the employers and the workpeople engaged therein." We have had discussions and conferences, committees and leagues, and what not, for the promotion of industrial harmony, but they have not brought an end to industrial unrest, which is the root-cause of low production. We have had elaborate movements in favour of Whitley Committees, which we thought would prevent disaffection by removing the causes thereof before they had time to develop. Yet these and Industrial Courts are found to be insufficient. We have had agitations for nationalisation engineered by those who contend that if we remove the obnoxious system of private ownership and let men work for the State, every man will feel in honour bound to give his best for the common good. But to many this is so thoroughly proved to be fallacious that they see in nationalisation a sure and certain measure for reducing, rather than increasing, production. We have had investigations of co-partnership proposals, but again and again they have been treated with scorn and derision. The nearest we have got to anything which appears to be a practical proposal for securing increased output is payment by results. Many men are making a good thing for themselves along such lines, and we doubt whether this new Committee will offer any better recommendation. An awakened conscience throughout the nation, securing to Capital and Labour alike a fair and reasonable share in the results of their efforts and abilities, would alone accomplish much; education regarding economic and industrial questions might remove ignorance which confirms men in the belief that they are doing well by their fellows in not working too hard, but education may fail to awaken a conscience. Let us have a committee therefore, take evidence, make recommendations, and hope that somebody will read the evidence and follow out the recommendations. We will save Old England's industries then by just one more committee. If it should happen that we do not succeed, we shall at least have one more and better way open—we can appoint yet another! By that time—.

The German Transmarine Electricity Works.

One of the greatest oversea undertakings established by German financial interests is now proposed to be transferred to foreign ownership. We refer to the German Transmarine Electricity Co., of Berlin, which owns extensive supply works at Buenos Ayres, and is also concerned with supply works and tramways in other parts of South America. The development of the company's activity in pre-war years was such that a sum of from 15,000,000 marks to 30,000,000 marks in gold was required almost every year to keep pace with the progress made. Owing, however, to the depreciation of German currency, it is considered that it would be impossible, even if it were desirable in the national interest, to raise such large amounts in the German market for foreign investments in the future. Under these circumstances, the situation of the German Transmarine Electricity Co. (D.U.E.G.) would remain stationary unless a way out of the difficulty were found which would permit of the future development of the undertaking.

According to reports in circulation in Germany, various foreign interests have sought to obtain possession of the company's undertaking in recent months, but the suggestions made in this respect failed to meet with the approval of the directors. Now, however, it is stated that a provisional arrangement, which has the prospect of becoming definite, has been entered into with a Spanish-international group which is to form a company, to be domiciled in Madrid, to take over the German company's assets in exchange for interest-bearing bonds and A shares in the Spanish currency. It is proposed, for instance, to allot for each German ordinary share interest bonds for 1,500 pesetas and 500 pesetas in A shares. The bonds are to receive out of the profits of the undertaking interest of up to 6 per cent., with cumulative rights for five years; whilst on the A shares will devolve one-half of the profits realised in excess of 6 per cent., and the other half will be retained by the Spanish company. The latter will provide the funds for the redemption of the preference shares in the Germany company at the price of 150 per cent., and of the loans issued by the latter, and will also raise the considerable amount of fresh capital which will be required for the future development of the undertaking.

The prospective transfer of the undertaking to foreign control is regretted in German industrial circles, although it is considered desirable to obtain securities which have a market abroad, and could be of advantage in the provision of foreign exchange. As far as the capital is concerned, the ordinary shares amounted to 120,000,000 marks, and they were recently quoted in Switzerland at 60 per cent. of their nominal value. The preference shares total 30,000,000 marks, and are redeemable at 110 per cent., whereas the Spanish offer comprises purchase at the price of 150 per cent., so that the holders of these shares stand to gain the most. In addition, the loan capital of the German company exceeds 105,000,000 marks. The holders of ordinary shares who have received no dividend since the end of 1916 will be sacrificing one-half of their prospects of profits by accepting 6 per cent. bonds, but, on the other hand, they have the right to 50 per cent. of the surplus remaining after the payment of the 6 per cent. It appears that at least one-third of the ordinary capital has been purchased in recent months for foreign account, chiefly Switzerland, and Swiss interests have sought to secure control over the undertaking, but the offers made are said to have been less favourable to the Germans than those put forward by the Spanish group, as above mentioned.

IMPROVISATION: AND SOME ACTIVE-SERVICE REMINISCENCES.

By G. E. MOORE.

In primitive life the faculty of invention or improvisation may be found in its essential. Pre-historic man discovered, by some process of reasoning or bitter experience, that a stone could be extemporised into an effective weapon. And he also found that the stone could be used as a tool. By subsequent expedients, through many years, the stone evolved into a much more efficient weapon or tool—until eventually it became the medium for still more effective substitutes.

The so-called *lodestone* is a particularly good example of a natural object being utilised with practically no modification. Some "heathen Chinee" of an inventor was not slow to realise its utility.

In the case of the simple stone an ordinary object was utilised first in its natural state, and later modified and improved. And looking back on the evolution of the stone, and, indeed, that of industry, all succeeding steps appear as a series of expedients, of improvisations, of progressive modifications—all impelled and stimulated by human wants and ambitions.

The impromptu-spirit does not seem to be encouraged very much in young folk nowadays. Ready-made toy devices of all kinds are on the market; although these are certainly an aid to ingenuity they can hardly be so effective as regards latent inventiveness, pride in achievement, and teaching any principles involved. The writer remembers some of his own early and rather pathetic experiments with extemporised odds and ends. Do boys still try to make frictional electric machines out of old whisky bottles, and wait under arc-lamp standards to beg carbon stumps for their home-made tomato-tin cells?

Jules Verne always credited his heroes with an extraordinary and unfailing skill in improvising. In the present epidemic of novels and film-dramas of the uninhabited island type, neither heroes nor heroines set about the provision of, say, a generating station and electric lighting, heating, and other devices out of "nothing." But perhaps that sort of stuff would be unacceptable. Surely this points to a general lack of electrical knowledge and of the handyman ability?

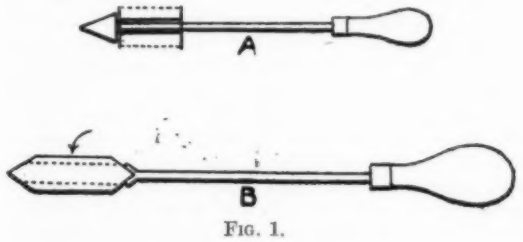


Fig. 1.

The great war was the cause of what may be termed a wave of improvisation. Britain was in many particulars utterly transformed. In the case of the Expeditionary Forces the need for improvising was of a much more pressing and primal nature—indeed, in many ways, life at the Front constituted the biggest lapse into the simple life ever experienced. The work of field companies of the Royal Engineers called for a considerable amount of improvisation, but apart from that there was a general incentive towards extemporising.

Was not the dug-out but an impromptu form of dwelling? And in the first gas attack in 1915, was it not a fortunate expedient thought of and acted on, on the spur of the moment, which saved the situation?

There is no doubt that during the first stages of the war the need for improvising was felt far more by our Army than that of the enemy, in view of the latter's thorough preparedness. Fortunately, "Tommy," whether of the old or new type, was not found wanting—look at the uses to which the "tin hat" was put, the biscuit-tin huts, and so forth. A book, or many books, could be written on this aspect of the war alone.

Many a linesman cursed that failing of the infantry (and especially the Portuguese), which oft-times meant that "'Dis' on such-and-such a line" was caused by somebody purloining a length of wire. It was difficult to cut, and the steel strands hardly improved a knife, but it was very useful for all manner of things.

In the technical corps improvisation of a specialised form was called for. In many cases, tools and materials might be conspicuous by their absence or painfully insufficient, and great difficulty would often be experienced in obtaining stores. You might, for example, urgently require a certain substance, and you would accordingly indent for 1 lb. of it. After the inevitable circumlocu-

Fig. 2.

tion, either of two things might happen: You would receive nothing at all, or you might get 1 cwt. of the required substance.

A few months ago the "Tucker microphone," a war invention, was examined by the Royal Commission on Awards to Inventors.* The idea underlying the microphone was not new; Dr. Eccles had made a hot-wire microphone before the war, and quite recently Prof. McGregor-Morris introduced an anemometer which depends on the same principle. The Tucker microphone was adapted to sound-ranging, and the experiments were carried out at the Front in the shell zone (research work which was noteworthy if only for that), the original microphones being crude but efficient improvisations of oil drums, hot-wires, and Wheatstone bridges.

The writer now proposes to describe a few "gadgets" more or less improvised on active service. It is to be regretted that many much more interesting electrical devices—examples of improvisation at the Front—must, on account of their military nature, remain unrecorded.

One instance the writer will always look back to with amusement. During several winter months he and a few others occupied a barn known as "Windy Manor"—*why* it was so named can be guessed! No candle could ever hope to survive many minutes on a windy night, and it was decided to light the barn electrically. A captured 12-volt accumulator (somewhat sulphated), some scraps of cable and bare wire, and one or two battered lampholders helped the "2-way intermediate" installation. The only lamps forthcoming were broken 100-v. metallic-filament ones. These were mended in the classic manner, and those which were persuaded to give a respectable light on 12 volts were retained. Even these flickered sometimes! Later, it was difficult to get volunteers to carry the accumulator to and from the generating station (a portable Austin set), which was a considerable distance away.

In instrument repair work a considerable amount of

* Elec. Rev., August 1st, 1919.

soldering of a fine nature was necessary, and the writer was asked to convert a light "iron" for electrical heating. A rough bobbin of metal was fitted on the stalk (fig. 1, A), and on this, with suitable layers of thin mica, the heating element was wound. The wire was of an alloy similar to constantan, of 18 s.w.g. (.048 inch nowadays!), and attained dull red heat with a current of about 2½ amps. (A large-capacity battery of Edison cells, 12 volts, was available.) Over the windings a layer of asbestos engine packing was placed. The heating wires were joined to flexible leads. Time taken to heat up, 3 minutes.

Crude though the iron was, it remained in almost daily use for over nine months, and it was still on active service when the armistice was declared. All ranks, including technical officers and visiting "brass-hats," regarded the little electric iron with an astonishment that was both laughable and flattering. One or two officers, who ought to have known better, were very sceptical concerning the conversion.

Later, another iron, and a much larger one, were also converted; in the latter the heating wires were laid in two specially-cut linear slots in the copper bit (fig. 1, B). Naturally, this method is the most efficient, inasmuch as the heat is produced where it is wanted, and conduction troubles are obviated. The iron in question took about 75 watts, and heated up in 4½ minutes.

Like the other smaller irons it never required a new heating element (fortunately!), and was in demand for several months. Sometimes it was left "on" for several hours by careless users. One such occasion was memorable. A coat was flung over the unnoticed iron,

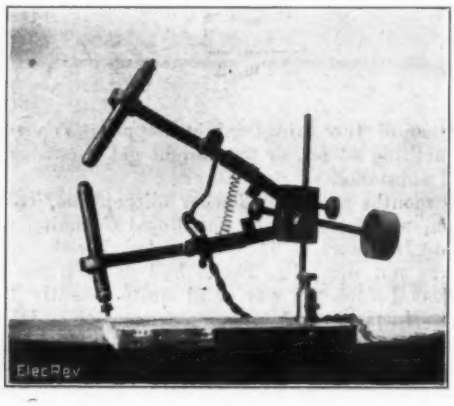


Fig. 3.

and when the owner returned two hours later he was puzzled to find that his coat had vanished. A prolonged search made him no wiser. Suddenly he noticed that the iron was covered with black ashes, and when he had recovered a sooty cigarette-case from these he realised what had happened.

These irons were by no means works of art, but they served their purpose very well. In connection with them the writer came to the same conclusions as Mr. C. Turnbull, who has recently contended in these columns that the bits and stalks of electric soldering irons should be in one piece.*

Another heater device was in the form of a "cigar-lighter" (fig. 2)—pipes and cigarettes not being barred. This was a mere luxury, of course, but in view of the match scarcity, very welcome. Thin resistance wire served as the heater, and in series with it was a length of thicker wire. The latter was placed inside a bottle, and the heater on the stopper. On the 12-volt circuit the lighter took about one ampere.

One day an officer of high rank appeared on the scene; during his *tour d'inspection* he found himself minus matches, and the cigar-lighter was handed to him. The astonishment with which he examined and applied the weird thing was very diverting, and it is certain that he regarded the lighter as probably the outstanding feature of his visit.

A surprising amount of heat was given out by the series resistance, and the cigar-lighter was more in demand for cold hands than it was for its legitimate purpose. This unexpected quality led to its disappearance, for it was afterwards found being used to warm the bed of a "billet." This is a startling example of improvisation—not every cigar-lighter can be turned into a bed-warmer at will.

Soon after the armistice a general slackening-off of work took place in those units which did not advance into Germany. It was decided by the writer and a friend that local concerts should be blessed with a lime-light equipment. Current was available, but very little else.

The most awkward proposition was the arc-lamp. With a few tools, odd terminals, scraps of metal, &c., and an enormous expenditure of energy, the handsome-looking apparatus shown in fig. 3 came into being. The makers were able to verify the dictum (attributed to Edison) that invention equals 10 per cent. inspiration plus 90 per cent. *perspiration*!

A petrol tin was then adapted to house the arc-lamp. A large convex lens was fortunately forthcoming, and the whole was fitted on a disused theodolite stand. There now remained the provision of a series resistance, as the pressure was in the region of 150 volts, and a "water rheostat" was made. Two more petrol tins were requisitioned, opened up, fitted in a wooden container, insulated with cleats, and given a couple of adjustable tin electrodes. An ammeter and D.P. switch —both of which had seen much service "up the line"— were fitted on the container. The electrolyte was salt solution—salt by kind permission of the battalion cook! The petrol tins could be put in parallel or series.

The *début* of the limelight set was not altogether a triumph. The carbons, on account of their origin (scrapped dry cells), spluttered abominably, and the arc wandered in a most irritating fashion. The water rheostat, too, required watching and adjustment owing to temperature rise; that, and the antics of the arc, meant a neglected stage—with an interesting innovation in stagecraft as a result: artistes had to follow the "lime."

These were not the only worries. The supply failed periodically—and the generating station (such as it was) was half-a-mile away. The electrician there undoubtedly felt neglected as regards the concert, and he had already shown animosity towards the arc-lamp. With a species of technical cunning which roused one's grudging admiration he had inserted a 5-amp. fuse in the circuit (the arc-lamp took 8 or 9 amps.), and every time the fuse blew he simply inserted another of the same size.

The arc-lamp distinguished itself for the last time at a lecture by Capt. R. W. James on the Shackleton Expedition, in which he was scientist. The arc-lamp was used inside a projection lantern, and for over an hour its behaviour left nothing to be desired. Then it became obvious that the tension of the spring was nil again, so the lower arm had to be moved up at intervals with a handy file. The lecturer's description of how the shore party extemporised a hut out of their boat was grimly appreciated by the lantern operator—between the shocks and burns.

The arc-lamp is now demobilised and on the reserve.

During the uneventful days which followed the armistice the writer and a friend essayed the construction of a simple wireless receiving set. This was a delightful example of improvisation. The inductance was made up of heavy gauge copper wire wound on a cardboard tea canister which had contained beef dripping (and hence was well insulated!). Tappings were led to a row of drawing-pins on a candle-waxed base. Connection was made by U-shaped brass clips.

A variable condenser was made from a dissected biscuit box and scraps of mica, a sandwich construction

* Elec. Rev., September 5th, 1919.

allowing one set of plates to be slid in or out. An electrolytic detector was easily extemporised, but it was later deposed by one of the crystal type. A broken Isenthal rheostat (a casualty of April, 1918) served as potentiometer. A brave attempt was made to construct a receiver, but eventually one had to be borrowed. Porcelain cleats and odd bits of ebonite acted as insulators throughout.

The erection of the aerial was by no means easy. It was composed of two 150-ft. antennæ, 3 ft. apart. After a vast number of attempts one end was eventually hauled up to the bend of a tree about 50 ft. above *terra firma*.

The other tree was lower, and was in a farmyard. An enormous amount of slime covered and lay under the tree, and whoever reached the top would do so at imminent risk of falling into the pond. But these dangers were as nothing compared to the opposition raised by the twenty-five fowls which inhabited the tree. According to the farmer, these feathered opponents of scientific progress served only one useful purpose in life; they woke him punctually at 5 o'clock every morning.

Strategy won the day. The erection of the aerial was concluded during the fowls' absence at *déjeuner*. A couple of Army pattern biscuit-tins in the pond formed a good "earth."

Other "gadgets" of the billet included electric lighting, a special device which would heat supper o' nights in readiness for the author's return, and an electric réveillé. This for a time took the form of a phonograph which at a predetermined hour began to play a *rousing* military air. Once it started five hours too soon, and after that a simple electric bell was installed. This was worked from the kitchen of the farm, and there a "je suis levé" message would illuminate by way of a reply.

All these little devices were held in great awe by the simple French villagers. When showing any visitors around the farm the programme of the "patron" would be as follows: The cows, the horses, the pigs, the wires which tapped "les messages de l'air," a peep into the room of "les ingénieurs anglais," the garden and orchard, and the electric réveillé. The latter was generally tested two or three times, much to the annoyance of the said engineers.

One day the farmer approached the writer regarding a little favour. Apparently the various "gadgets" had stimulated his mind, for he said that whilst he considered the horse far superior to any engine for farm work, he was not averse to electrical illumination, and would the writer rig up a dynamo and lights which would never cost anything and continue to work as long as he lived.

The author was very sorry—it was a great misfortune, but he was afraid his knowledge of improvisation was unable to meet the case.

ELECTRICITY IN THE WESTERN WAR ZONE.

By Major T. RICH, O.B.E.

(*Concluded from page* 892.)

Pre-war Systems of Supply.

Three-phase supply at 50 periods is very usual throughout France, both for transmission and L.T. distribution. In one area to the north of Paris 2-phase energy is supplied; in Paris and in the south, odd periodicities are to be found. Single-phase is employed in some areas, for instance Paris Plage and Berck Plage. In a number of places, such as Boulogne, Amiens, and Rouen, where the supply is of long standing, D.C. is used in the original distributing area, and 3-phase H.T. and L.T. energy supplied in outer areas or for long lines. The use of step-up and step-down motor-generators for the supply of new areas with light and power, which is a frequent feature in England, is avoided by the direct supply of 3-phase energy through transformers.

The usual voltage for lamps varies from 110 to 125, the latter in very few places, and 190 to 220 for power. In textile mills, where the power consumption is high, and separate transformer stations are usual, a pressure for motors of 440 volts across phases is often adopted.

Current according to French regulations is divided into two categories, up to 600 volts to earth D.C., and 150 volts to earth A.C., and the second category above these voltages. As the lower category carries with it various advantages regarding first cost, lamps on A.C. at 110 up to 125 volts are very usual. In some areas 220/220 volts D.C. is to be found, but in most of the smaller stations having D.C. 110/110 volts is used. By far the largest proportion of the lamps sold in France are for the lower voltages. French practice is very similar to American with regard to lamp voltages on 3-phase or single-phase circuits. From the point of view of safety, price of lamps, life and fragility of lamps, effect of lighting per watt, and the cost of installation, this voltage has still many points in its favour, the introduction of metallic lamps making the cost of copper in house circuits less than before. Improvements in transformers have reduced the increase in losses with small distributed sub-stations. Factory owners are beginning to use 3-phase energy much more than D.C., the latter being used mainly where existing plant has to be extended. There are very few classes of work for which 3-phase motors cannot be used, and it is probable that before long variable-speed commutator motors will be available for all classes of work.

In many areas power is purchased in bulk by distributing companies, in which the parent company often has a share holding. In the neighbourhood of St. Quentin an agricultural co-operative society purchased power in bulk and distributed it to a number of villages and small towns; as agricultural societies are rarely wealthy, this fact shows what can be done with reasonable capital expenditure and fair conditions. With regard to overhead H.T. mains, it is noticeable that where electricity supply is controlled by financial interests owning cable factories, there is often a greater tendency to use cables than when the supply company is independent. Difficulties of post-war finance will probably modify this tendency.

French High-pressure Voltages.

Up to the outbreak of war there was little standardisation of H.T. voltages, and it must be said that provided the periodicity is the same, standardisation in this direction has not the same value as it has, perhaps, in other sections of electrical work, owing to the ease of interchange. Some of the older systems were at 3,000 volts, for instance Dunkerque and the outer suburbs of Dieppe, other systems at 5,000 volts, such as Calais, Boulogne, Havre, and part of the area around Bethune and Arras, Douai, Cambrai, and near Rheims. Rouen was supplied at 5,500 volts, Charleroi at 6,000 volts, and Roubaix, Tourcoing, part of the Lille area, Ostend, Malines, Dieppe district, and a number of areas in the south at 10,000 volts, with 10,500 volts at Valenciennes and Maubeuge.

The pressure of 15,000 volts is very popular throughout the north-east and east of France. It is about the highest voltage which can be adopted for village distribution, with comparatively inexpensive sub-stations

and apparatus; as noted elsewhere, the Germans supplied a number of 2-K.V.A. single-phase and 3- and 5-K.V.A. 3-phase transformers for this voltage to the western front. This voltage has been adopted for general reconstruction work in the north-east for places where there are no underground cables *in situ* which will stand such a pressure. The same voltage was used before the war considerably in Belgium both for overhead and underground lines. It might be pointed out that the Germans used this voltage for practically all their new independent distribution systems from Laon and Charleville to the Belgian coast.

Among the E.H.T. voltages used in east and north-east France the following are to be found: 30,000, 45,000, 65,000, and 90,000; and 110,000 will probably be used for some of the new main trunk lines. Continental engineers are very much amused when they hear that anything over about 3,000 volts is termed E.H.T. in the United Kingdom; the continued use of such a term at home frightens local authorities and damages our reputation abroad. An extensive system of trunk lines at 45,000 volts was erected before the war by the Compagnie Electrique du Nord and its allies, starting from Pont-à-Vendin near Lens, where a by-product power station was situated, and passing Douai and St. Quentin, it linked up to a turbine steam station at Beauter on the Oise, a route distance of 80 or 90 miles, with branches to Laon, Soissons, Noyon, Compiègne, and with further links under construction towards Paris and the west. The overhead mains of this company were carried in the northern section mostly on lattice posts along a canal, and on the southern section along the roadways by armoured concrete posts. It is interesting to note that, except when there were direct hits, armoured concrete posts and structures stood up during the war against shell fire and explosion remarkably well. This company sold energy in bulk to several local distributing companies, the distributing voltage being 15,000 in most cases. The Germans after their advance in 1914 occupied practically the whole of the area served by this company, took over the power stations, and found their system of mains so useful that a pressure of 45,000 volts was adopted for the main military trunk lines for the northern section. The Société Béthunoise, and the Artésienne Co. adopted the same pressure for their trunk mains in the area occupied during the war by the British.

An extensive series of 30,000-volt lines exists to the east of Paris in the area between Rheims, St. Dizier, and the Briey Basin. In the Vosges area there is a system at 65,000 volts running north and south, connected near Belfort to a colliery station burning a somewhat low-grade coal, and to a Franco-Swiss water-power station. Up to the present there have been few if any E.H.T. systems in Belgium.

Power Stations in France.

The largest power stations are to be found in the colliery and industrial areas between Calais, Roubaix, and Jeumont. Practically all supply 3-phase energy generated usually at 5,000 or 10,000 volts. Three stations were in the suburbs at Lille, one at Croix Wasquehal to the north-east with 35,000 KW. installed; part of this plant was removed by the Germans and part damaged; at Usine Lomme, 20,000 KW., most of the plant was removed, and the turbine house blown up; at Sequedin, 20,000 KW., the plant was either removed or damaged. There are four power stations in the colliery area Pont-à-Vendin, Henin-Lietard (mainly colliery supply), Bully-Grenay, and Bruay, with several private colliery and other power stations. Other stations are at Valenciennes and Jeumont; the latter belong to the financial group which is controlled by Baron Empain, and owns the largest electric manufacturing works in the north of France, and also large works at Charleroi, and about half the electric power stations in Belgium. In the coastal sector there are power stations at Dunkerque, Calais, Boulogne, Amiens, Havre, and Cherbourg, with several smaller stations elsewhere and small local water-mill installations giving public supply.

In the newer stations steam turbines are usually installed, although auxiliary supply is in some cases given by blast-furnace gas engines. The stations are in most cases alongside rivers, but at Wasquehal cooling towers are used. The Germans with the aid of their customary patent-mongering bluff, had almost a monopoly of cooling-tower building in France before the war. On the whole, steam turbine-driven auxiliaries seem to be favoured. A number of chimneys were seen made with armoured concrete formed blocks, with vertical key reinforcement. On the Continent steam turbine floors are usually kept higher above the condenser floors than in the United Kingdom. Some very complete conveyor plant was installed in some cases.

Due to a large extent to the clear atmosphere, and partly perhaps to the painting, tiles, or light steelwork, power stations have not usually that dingy effect so often noticed in England. Owing partly to the original necessities of the glass industry, the use of very wide spans of 100 ft. or more, with north lights, is not unusual in Flanders for factories; in some cases the roofs are non-combustible, with two layers of interlocking tiles and no woodwork. The cross girders are usually worked into the frame carrying the north lights.

Power Stations and Systems in Belgium.

In general the power stations in the area occupied by the British troops or adjacent areas do not differ greatly from those in France. A certain number of the companies supply 42-period, 3-phase energy. Owing to the density of some of the areas supplied, the narrow and winding roads in many parts, and local prejudice, there is much less overhead line than in France; although, owing to the necessity for economy in expenditure, according to information received, there will probably be a great increase in overhead line in the future. The L.T. distribution is in many places 3-phase. A power station at Ostend supplied power and light along most of the coast by means of cables. The Germans used energy from this station and from stations at Bruges and Zeebrugge for lighting dug-outs, batteries, and depots all along the coast.

Electricity on Board Ship. — Several motor-driven oil tankers without sails are on order, one being under construction, for the Standard Oil Co., of California, at the yard of the Union Construction Co., Oakland, California. The engines installed will comprise two 550-B.H.P. sets, running at 165 R.P.M., the speed of the vessels being 11 knots. In most motor oil tankers, the auxiliary machinery, which has to be fairly high-powered on account of the fuel pumps required for pumping out the cargo, is steam-driven, but in this vessel the electric drive is adopted throughout. The power is supplied by two 150-B.H.P. ordinary stationary Diesel engines of the Dow Diesel type, manufactured by an American firm with a licence for the construction of the Willans and Robinson Diesel engine as built at Rugby. These engines, which are of the three-cylinder type, are each coupled to a 100-KW. generator at 250 volts. The electrically-operated auxiliary plant includes the two cooling water pumps, two lubricating oil pumps, one of which is a spare, an auxiliary air compressor for the supply of manœuvring air at a pressure of 50 lb. per sq. in., a three-stage turbine pump used for fire and bilge purposes, and a two-stage turbine pump for sanitary purposes. The employment of turbine pumps for this purpose is interesting, as the plunger pumps are more common. In addition, there is a centrifugal fresh-water pump, whilst there are four oil pumps, all electrically operated, these being used for discharging the cargo. The lighting on the ship is at 125 volts, and a small booster is fitted to provide for this. Even the heating is carried out by electricity, special electric heaters being used, whilst the cooking is all effected by electric power, the equipment being furnished by the Edison Electric Appliance Co. On deck there are four cargo winches, driven by 15-H.P. motors, and two capstans, driven by 10-H.P. motors, besides an anchor windlass, coupled to a 25-H.P. electric motor, and the steering gear is of the hydro-electric type. The only steam that is used is for steaming out the cargo tanks, and for this purpose a small donkey boiler is fitted, which may also be used as an evaporator. The only auxiliary plant in the engine-room, apart from the main Diesel-driven generators, is a 16-H.P. Skandia emergency set driving a 7-KW., 250-volt generator. With all these novelties, the vessel is obviously one of considerable interest, in spite of the fact that it is relatively small.—*Motor Ship and Motor Boat.*

THE POULSEN ARC IN WIRELESS TELEGRAPHY.

Much has been heard of the Poulsen system in general terms during the last 10 years—but very little in the form of precise details, and the development of other and newer methods of generating continuous waves, such as the high-frequency alternator and the vacuum valve, has further tended to promote the impression that the arc as a generator is passing into the class of things that have been. This, however, is far from the truth, as we shall show below. Not only is the Poulsen system very much alive, and maintaining communication to-day over the longest ranges ever attempted on a commercial scale—it is also being installed for long-distance communication in high-power stations in this country and abroad, as well as in numerous stations and ships for shorter ranges.

Fig. 1.—Map showing some Long-distance Poulsen Transmissions.

Fig. 2.—Flying-boat in Collision with Elwell wooden mast at Horsea Island Naval Station.

It will be remembered that at the Parliamentary inquiry regarding the contract for the Imperial Wireless Chain in 1913, the Poulsen system was put forward as a practicable alternative to the Marconi system, largely on the strength of the establishment of communication between San Francisco and Honolulu, but the evidence available regarding the results obtained was meagre and unconvincing. That was, at the time, the longest range in commercial operation (2,100 miles), and the installation was carried out by the Federal Telegraph Co., U.S.A., of which Mr. C. F. Elwell was the chief engineer. In order to make clear the course of events, a brief outline of the history of the system and Mr. Elwell's connection with it is necessary.

Mr. Elwell, an Australian by birth, received his scientific training at the Stanford University, California, where he graduated as B.A. in Engineering in 1907, and E.E. (Electrical Engineer) in 1908. He specialised in the subject of wireless telegraphy, and in 1909 he visited Denmark, and studied the Poulsen system, eventually purchasing the U.S.A. patent rights. Returning to America, he founded the Poulsen Wireless Telegraph and Telephone Co., of which he was managing director and engineer; later this concern was merged in the Federal Telegraph Co., with Mr. Elwell as chief engineer until 1913, when he became chief engineer to the Universal Radio Syndicate, a company with an option on the Poulsen arc patents for the rest of the world, except the United States. This company went into liquidation, and in 1915 Mr. Elwell commenced business on his own account and carried out a large amount of work during the war. Throughout his career he has been closely identified with the Poulsen system, and has developed the arc generator from a capacity of 30 kw. to 400 kw., having built and installed 11 machines of 200 to 400 kw. during the war, and having

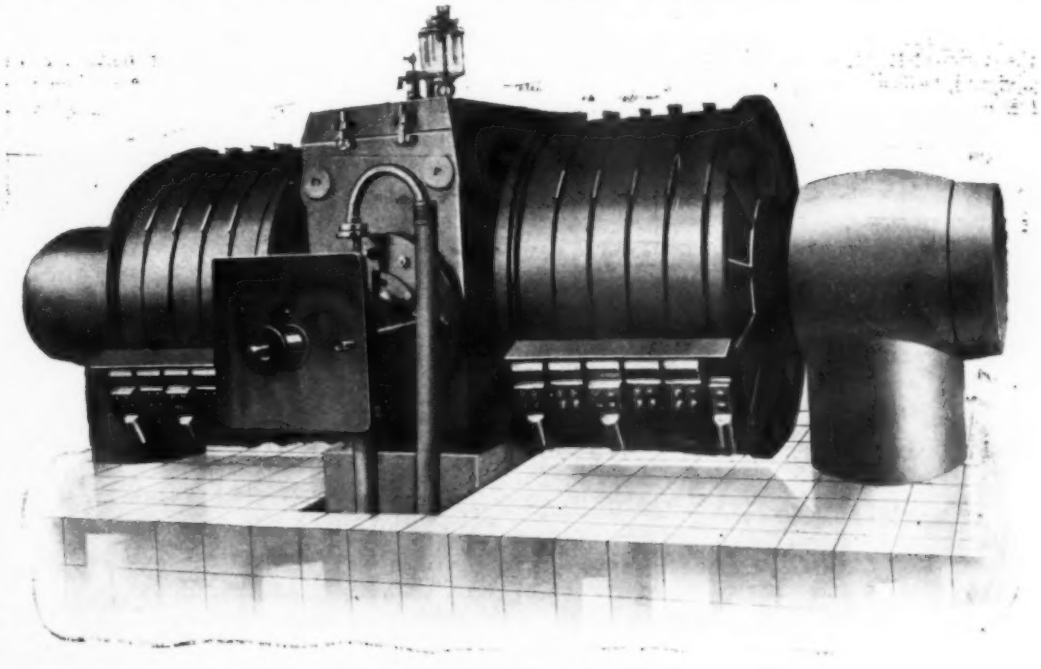


Fig. 3.—Elwell-Poulsen 350-kw. Arc-generator at Lyons.

designed and built in all about 500 masts of various lengths up to 714 ft. Of the total of 20,000 KW. of arc generators now in use, about half have been designed and built by the present organisation, and most of the remainder by the company which he organised. Amongst the installations designed and built by Mr. Elwell are the stations, including

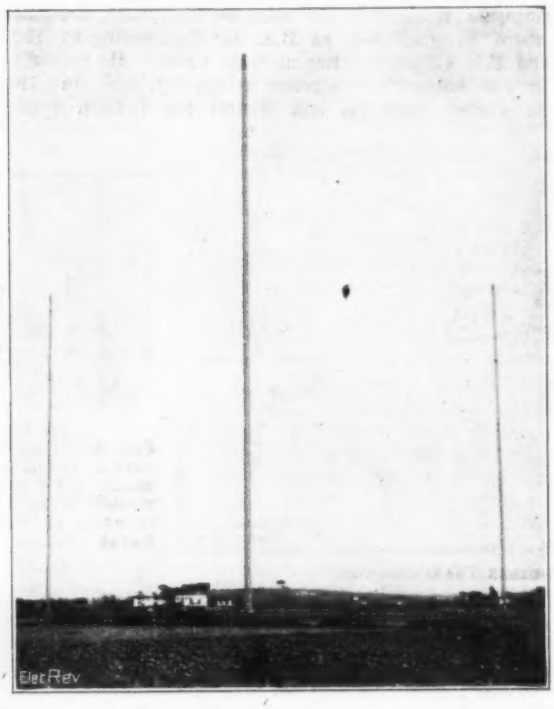


FIG. 4.—ELWELL 714-FT. WOODEN MASTS AT ROME.

masts and apparatus, at Honolulu and San Francisco, communicating over a range of 2,100 miles; the station at Horsea Island, Portsmouth, with a range to the Dardanelles; and the station at Rome, working to the United States. He also designed, built and installed apparatus at Lyons and Nantes, communicating with the United States, at the

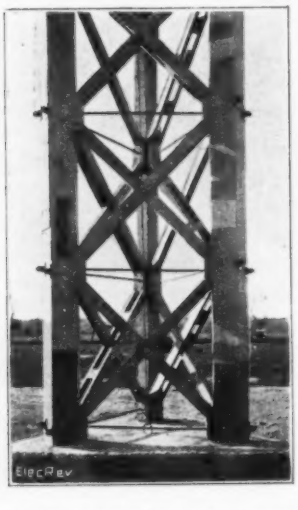


FIG. 5.—DETAIL OF MAST CONSTRUCTION.

Eiffel Tower communicating with Bucarest, and at Salonica, communicating with Paris, as well as many smaller sets, including 13 25-KW. sets for the British Admiralty, and many sets installed in the British Colonies. He is now building the arc apparatus for the first two stations of the Imperial Chain to the order of the British Post Office Department.

It is interesting to note that Mr. Elwell's masts are al of the wooden lattice type, the three at Rome which w illustrate being 714 ft. high, while two at San Francisc and Honolulu are 606 ft. in height. The three Horse masts are 440 ft. high, and one of these successfully with stood the impact of a large flying boat (fig. 2).

The accompanying map (fig. 1) shows some of the long-distance transmissions over which commercial service is maintained with the Poulsen arc generator, minor routes

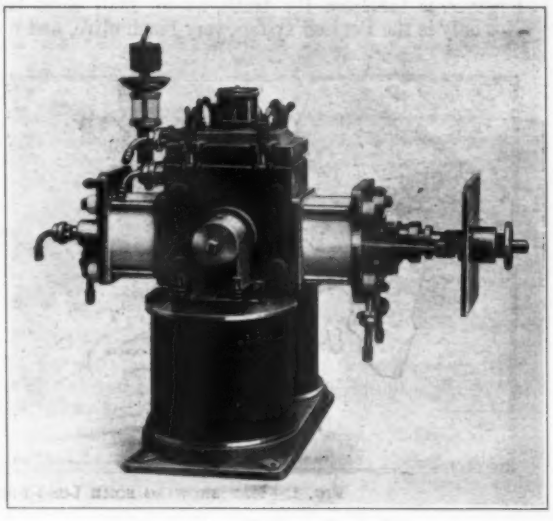


FIG. 6.—ELWELL 10-KW. ARC GENERATOR.

having been omitted for the sake of clearness. The Paris-New Zealand range is a "freak" record, but the rest are in continuous operation, and we may draw attention to the transmission from Lyons to Shanghai of 5,810 miles over-land (also to Japan), and Cavite-Honolulu-Darien, tw stretches over 5,200 miles. A 5-KW. Elwell generator has been heard at a distance of 3,500 miles—of course, a "freak." A station now being built for the French Government is to be equipped with a Poulsen arc-generator rated at 1,000 KW., by the Federal Telegraph Co., U.S.A.

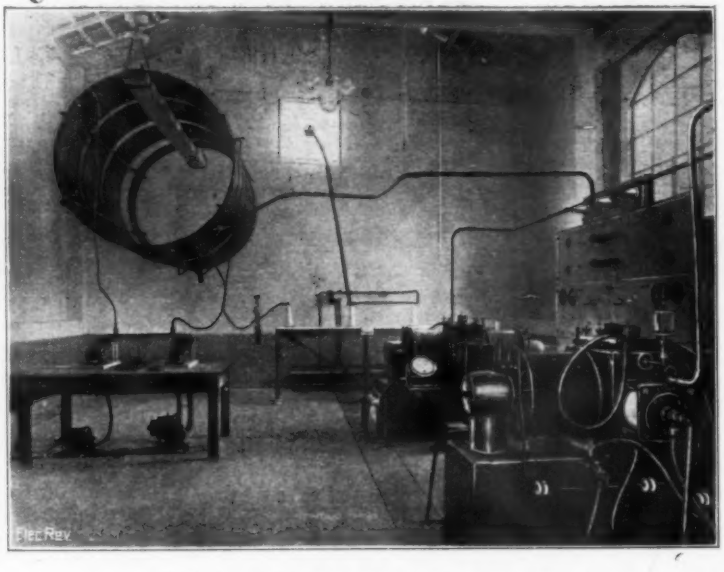


FIG. 7.—INTERIOR OF THE STATION AT ROME.

For the help of readers who are not familiar with the Poulsen system, we may mention that it depends upon the formation of an arc between a copper anode and a carbon cathode in a chamber filled with hydrocarbon gas; powerful electromagnets maintain an intense magnetic field at right angles to the arc, and the cathode is slowly

rotated to keep the length of the arc constant. An oscillating circuit consisting of capacity, the antenna, and inductance is connected in series with the arc, as shown in the diagram of connections, fig. 11, and in this circuit powerful undamped oscillations are set up, radiating from the antenna a continuous stream of undamped waves. In order to send signals, a key is used which short-circuits a few turns of the sending inductance, and thus alters the wave-length by about 1 per cent. Tuning, with continuous waves, is so sharp that the receiving apparatus only responds to the latter wave-length, and is not affected by the slightly different wave-length radiated when the sending key is open. As the frequency of the waves is far above the limits of audition, the heterodyne method of receiving is employed, by exciting the receiving aerial at a frequency differing slightly from that of the signalling waves, thus producing beats at a frequency which can be heard in a telephone-receiver, and which can be adjusted at pleasure to suit the operator's choice.

Very heavy high-frequency currents can be obtained in the antenna with the arc-generator, about 50 per cent. of the power put into the arc being delivered to the antenna. The arc chambers in all but the smallest sizes have to be water-cooled, as well as the copper anode, and provision is made for introducing either coal-gas or a hydrocarbon liquid (by drops) into the chamber. Fig. 3 shows a set installed at the transmitting station at Lyons, which is similar to, but of more modern design than, those which were installed at Rome for communication with America and the Italian Colonies in Africa, when urgently required during the war; the arc-chamber—a double-walled gunmetal casting—occupies the centre, with the magnet coils on either side; the yoke of the huge magnet, of which the ends are visible, is for the most part concealed in the foundation block. At the front of the arc chamber are seen the device for striking the arc, and the water-pipes. This set is rated at 350 KW.; the generator at Rome (fig. 7) is rated at 200 KW. (250 amperes at 800 volts), weighs 3·75 tons, and is provided in duplicate. In the case of these large sets, remote control with contactor switches is employed: the control board consists of five marble panels, two for each arc-generator and a change-over panel. The series resistance used for starting the arc is cut out by five contactors controlled by a master switch. The cooling water supply for the arc-generator is electrically interlocked with the D.C. supply, and in the latest patterns the whole of the processes of starting up are carried out with a controller, which ensures the operations being performed in the correct sequence. The sending inductance at Rome has a value of 2,500 microhenries, and consists of a spiral of 1½-in. copper tubing suspended on insulators. Choke coils, necessary for the protection of the dynamo, have each an inductance of 5,000 M.H., and are wound with flat copper strip; we may mention that the high-frequency currents behave in a manner which would astonish the engineer accustomed only to ordinary alternating currents, for small capacities are open doors to them, and unless expert care is employed to confine them strictly to their lawful circuits they make their appearance in most unexpected places, "play the devil" with insulation, and provide unpleasant (though not dangerous) traps for the unwary operator.

A motor-generator consisting of a three-phase motor coupled to a 350-ampere, 750-volt dynamo provides the current for the arc circuit.

The distance over which good communication was desired at Rome was 4,200 miles, necessitating a lofty aerial

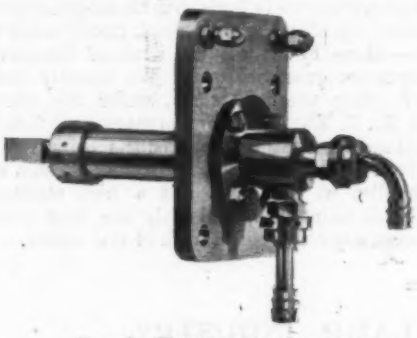


FIG. 8.—WATER-COOLED ANODE.

FIG. 9.—WATER-COOLED CATHODE.

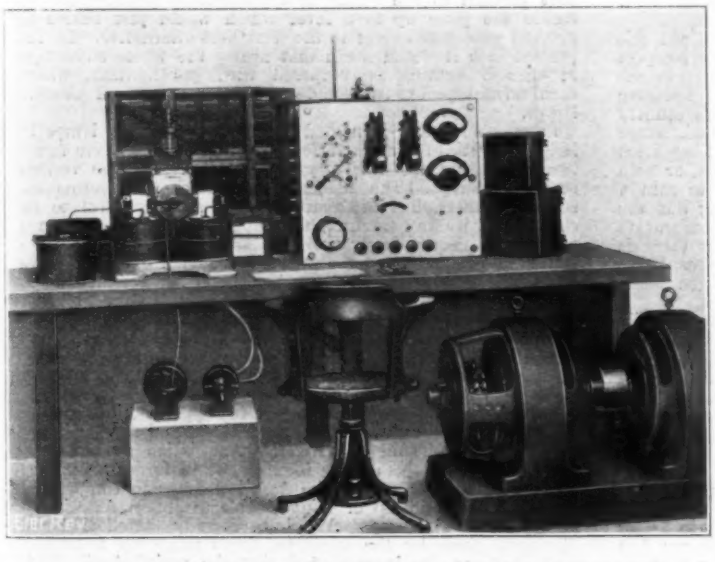
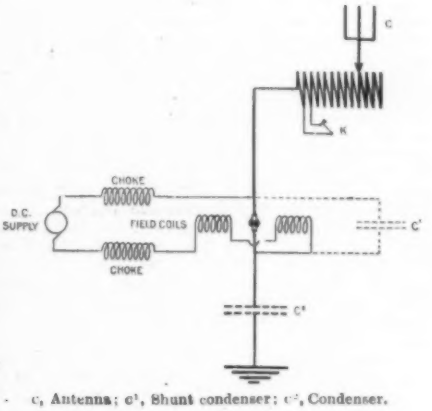


FIG. 10.—COMPLETE 5-KW. ELWELL-POULSEN INSTALLATION.



C, Antenna; C', Shunt condenser; C², Condenser.

FIG. 11.—DIAGRAM OF CONNECTIONS.

Owing to the scarcity of steel, of which 300 tons would have been required, it was decided to construct the masts of pitch-pine, the quantity of timber needed being 105,000 board feet. The horizontal component of the antenna pull was 22,000 lb., and the maximum stress allowed in the wood was 1,000 lb./sq. in. The masts were built in 11 sections, supported by 11 sets of three guys at 120°. The section of the bottom columns was 12·6 × 16 in., and of the top 12·6 × 7·1 in. The three masts are shown in fig. 4, and a detail of the foot of a mast is given in fig. 5.

The masts were placed at the corners of an equilateral triangle with sides of 984 ft., and the triangular antenna had a capacity of 0·011 mfd. The counterpoise consisted of buried copper wires extending over an area greater than that of the antenna, and supplemented by wells leading down to the ground water.

Fig. 7 shows the interior of the station at Rome, with the arc generators and switchgear on the right, and the sending inductance and electromagnetic keys on the left. The high-frequency lead passes up to a sheet of glass in the wall of the building, at the centre of which is mounted a large porcelain insulator, through which the cable is taken to the antenna.

The Elwell-Poulsen arc equipments range from 2 KW. to 400 KW., in 13 standard sizes, of which the 5-KW. set is the most widely used—some 800 stations having been equipped; up to 25 or 30 KW. the apparatus can be installed, with all accessories, in an ordinary room. We illustrate in fig. 6 a 10-KW. generator, with which continuous communication can be maintained over a range of 700 miles. Figs. 8 and 9 show the water-cooled anode and cathode for this size, and fig. 10 a complete 10-KW. installation.

Improvements are constantly being introduced, and the speed of transmission has been raised to 100 words per minute by automatic operation. Amongst the stations at work or building with Poulsen arc-generators of 100 KW. and upwards, some 24 in number, in addition to those mentioned above, are those at Bordeaux, Cairo, Cordova, Leafield, and Newcastle, and about eight in the United States. Mr. Elwell's headquarters are in Paris, but his arc-generators and other apparatus are all made in England, mostly at his works in London—where, by the way, the whole of the male staff and employés are ex-service men. We recently had the pleasure of going over the works, under the courteous tutelage of Mr. B. Mittell, London manager, and found the visit exceedingly interesting, the products being in a class by themselves. All parts are made to gauge, so that spares can be supplied at any time, and a high standard of workmanship is maintained, while only the best materials can be successfully employed in work of this nature.

REPORT ON THE ELECTRIC LAMP INDUSTRY.

(*Continued from page* 414.)

6. The evidence we have heard goes to show that in the existing state of the lamp market the retail prices fixed by the Association become the standard retail prices for all lamps, whether manufactured by Association or non-Association firms. Whilst non-Association manufacturers allow greater discounts to the middleman, their lamps are bought by the general public at the same prices as Association lamps. We have sought to ascertain why non-Association agents serving the general public do not seek to increase their trade by selling at less than the Association prices. It has been explained to us that at the moment they can sell, at prices fixed by the Association, all the lamps they can obtain, and would find no advantage in selling to the public at a lower price—in fact the public would doubt the quality of a lamp offered below the recognised Association price.

The unanimity of the witnesses to whom we have put this question forces us to the conclusion that there is no prospect of the prices fixed by the Association for lamps sold to the general public being subjected to any effective competitive check (so far as non-Association lamps made in this country are concerned) until such time as the supply of electric lamps considerably exceeds the demand. If and when that condition obtains some non-associated makers or large retailers, or both working in conjunction, might make an attempt to gain a wider market by cutting the Association list price; but the hazard would be great, and the inducement to conform to Association list prices is so strong that we consider there is no great probability of the Association's list prices being seriously influenced by the fear of competition from home manufacturers in any foreseeable future.

Nor would foreign lamps, even assuming open ports, easily find their way through the normal distributive channels, for it is to be noted that the agreements under which the vast majority of distributors handle Association lamps are directed against imported lamps (except such as may be imported by the Association) equally with non-Association lamps manufactured at home. In one respect potential competition from abroad is more formidable than home competition. American, Dutch, and perhaps German manufacturers, in that they have far greater financial backing or may be able to produce at far lower cost, might have an inducement and a power to challenge the Association monopoly in Great Britain to better purpose than any non-associated home manufacturers; but from evidence laid before us we incline to the view that an international agreement between the British, American, and Dutch electric lamp combines might forestall any threatened battle royal between the respective national groups.

We are therefore of opinion that, apart from some public accountancy of costs, prices, and profits, supplemented by power of control should necessity arise, the determination of what is a "reasonable price" for electric lamps sold to the general public will rest with the Electric Lamp Manufacturers' Association. We do not suggest that the Association would necessarily pursue a policy of inflated prices and inordinate profits, but wish merely to point out that if they decided to do so there would be no effective check in the shape of competition.

It was put to us that the fear lest the Electric Lamp Manufacturers' Association should use its monopoly powers to exact unreasonably high prices was unfounded, in that the electric lamp is in competition with the incandescent gas light, and that the result of raising prices above a certain level would be the displacement of electric lighting in favour of gas lighting. We agree that this consideration must influence to some extent the price of electric lamps, but we would remark that the price at which electric lamps are sold ought to depend either upon competition between independent lamp manufacturers or upon the gross cost of production of the lamp, and not upon the comparative cost of gas and electric lighting. If the latter proposition were generally accepted it would mean that any Association of manufacturers having an effective monopoly of a given product instead of selling that product to the public at a competitive price, could increase the price up to a level which would just suffice to prevent people resorting to the next best alternative. In the present case it would mean that nearly the whole advantage of electric lighting as compared with gas lighting, where such advantage exists, would go to the makers of electric lamps.

Large consumers, as named in paragraph 5, buy lamps in large quantities for use and not for sale, and some have facilities for testing the efficiency and durability of the various makes of lamps. The Association makes special terms for such customers, but those are too big and powerful to be constrained by any exclusive dealing agreement, and are in a position to choose freely between Association and non-Association lamps. One non-associated maker from whom we have taken evidence (there may be others) has abandoned the attempt to supply the general public, and confines himself to these large users. Here competition is free, and the maker who can offer the best value, in terms of price and quality, can get the order. We consider it noteworthy that in many cases non-associated makers are able to secure orders from these large users in competition with firms in the Association

7. Non-associated firms which look to supply the householde with lamps are compelled to offer the factor and retailer large discounts than would be given by Association makers—this in order to give them some inducement to forgo the preferential discounts offered by the Association, or to compensate them for the handicap of being unable to obtain Association lamps on trade terms. We have already stated that the discounts given by the associated firms range up to 39 per cent., but we also learn that during the period April, 1914 to June, 1916, the discounts given by associated firms were raised by 7½ per cent. on drawn-wire lamps and by 10 per cent. on squirted-filament lamps, making a total maximum discount of 46½ per cent. and 49 per cent. respectively. These are more than ample discounts, but instances have been cited to us of non-associated firms giving discounts as high as 60 per cent. It should be understood that those maximum discounts are given only to the largest factors, who usually sell lamps wholesale to the smaller retailers, and that the factor in reselling the lamps to the retailer retains only the difference between his factor's discount and the discount which he allows to the retailer. But making every allowance for this, we are convinced that the discounts given in the electric lamp trade are larger than is necessary, the more so in that most electric lamps are widely advertised "pro-

prietary articles," and as such should carry minimum discounts. It is a trade custom to economise on discounts what is spent in advertising. In the electric lamp trade lavish allowances are made on both scores.

The manufacturer, we understand, accepts responsibility for the lamps reaching the trader in sound condition; thus the trader, by examining his consignment on arrival secures himself from loss by fault or breakage. Subsequent deterioration or breakage can be provided against by proper storage facilities. By economies in the cost of distribution alone, apart from any reduction in the manufacturers' prices, it should be possible to reduce the price of lamps to the public by 6d. each.

The fixed-price policy, however, precludes any such economies being made in respect of distributors' margins. Such competition as there still is between associated and non-associated firms works out—under present conditions—as a competition not in price to the public, but in discount to the trade. The fixed-price policy is supported by its promoters and advocates on the ground that it gives the small man the same chance of selling lamps as the large man. It does, but it gives the large man much bigger profits than the small, and prevents the public from obtaining electric lamps at any lower price than will enable the smallest and most inefficient retailer to make a comfortable profit on their sale. We have no desire to see the small shop submerged by the big store, and would be disposed to approve any arrangement whereby they were placed on the same footing as regards the price of their purchases. The policy followed by the Association does not place them on any such footing of equality. It is generous to the small retailer but lavish to the large retailer. Certain other combinations and consolidations producing proprietary articles at fixed retail prices have found it practicable to give a flat rate of discount to all retailers, large or small, and we consider that the Electric Lamp Manufacturers' Association will have fallen short of its declared aspirations to sell the best lamp in the largest quantity at the lowest price unless and until it puts its discount policy upon that basis.

We have next sought to ascertain the prices obtained for standard vacuum lamps by Association and non-Association manufacturers from the trade or from large users. We have already referred to the maximum discounts of 49 per cent. and 60 per cent. respectively, given to the largest factors or users, in some cases at certain periods. These figures serve to show that lamps bought by the public at 3s. have in those cases been sold, presumably at a profit, by the manufacturers to the trade or to large users at approximately 1s. 6d. and 1s. 3d. But these are not wholly representative figures, in that the *average* discount given is something less than the *maximum* discount. Our inquiries as to the *average* price received by manufacturers over the whole range of their sales have adduced information which we cannot verify, and which does not lend itself to presentation in a form permitting of unquestionable deductions. We must, therefore, be content to record that we have been furnished with information indicating that the average price received for standard vacuum type lamps, with drawn-wire filaments, by four of the largest Association firms, was 1s. 8¼d. in 1913, and 2s. 2d. in 1919, and that from another quarter we have received evidence which is embodied in the following table:—

STANDARD VACUUM WIRE-FILAMENT LAMPS.

Period 1912.—	Low volt (20-60 watt).	High volt (30-60 watt).
	s. d.	s. d.
Price to British consumer	2 6	3 0
Association price to ungraded retailer	2 0	2 4½
Association price to large factor ...	1 6¼	1 10
Non-Association price to large factor...	9	1 1
Period September, 1913, *to April*, 1917.—		
Price to British consumer	2 2	2 6
Association price to ungraded retailer	1 8¾	2 1½
Association price to large factor ...	1 4	1 7½
Non-Association price to large factor...	8	11¾
Non-Association price for export ...	6	
Period April, 1917, *to December*, 1917.—		
Price to British consumer	2 6	3 0
Association price to ungraded retailer	2 0	2 4½
Association price to large factor ...	1 6¼	1 10
Non-Association price to large factor...	10¼	1 2
Period December, 1917, *to present day*.—		
Price to British consumer	3 0	3 6
Association price to ungraded retailer	2 4½	2 9½
Association price to large factor ...	1 10	2 1½
Non-Association price to large factor...	1 7¼	1 10¾
Association price to large factor for export	1 4½	1 7½

It has been submitted to us, in criticism of these figures, that they refer to purchases or quotations on very large quantities, and cannot be taken as representative of the average prices received from the trade, either by Association or non-Association manufacturers, and that the price to the retailer and factor was lower from April, 1914, to June, 1916, by virtue of the additional discounts given during that period. We have taken account of these objections, but are satisfied as to the substantial reliability of the figures given above.

We have further been supplied by a large corporation, which has for many years past bought electric lamps in considerable quantities, with particulars of prices quoted by the Association group and by five non-associated firms during the past six years. The discounts from standard prices have been deducted to show the net price per lamp quoted to the corporation. The price to the consumer in the several years is also shown:—

COMPARISON OF NET PRICES QUOTED TO A CORPORATION FOR STANDARD VACUUM WIRE-FILAMENT LAMPS.

HIGH VOLT (25 AND 50 C.P.).

	Association. Retail price list.	Association. Net price quoted.	Non-Association. A.	B.	C.	D.	E.
1914 ...	2/8	1/7·48	1/3·75	1/2	1/4	—	—
1915 ...	2/8	1/9·76	1/3	1/2	1/4	—	—
1916 ...	2/8	1/6·94	1/3	1/1·6	1/4	—	—
1917 ...	3/-	1/5·52	1/3	1/1·8	1/1	—	—
1918 ...	3/6	2/6·24	—	2/1·2	—	—	—
1919 ...	3/6	2/3·46	—	2/1	2/1	1/11	1/11¼
Jan. 1920	3/6	2/3·46	—	2/1	1/11·8	1/11	2/1

LOW VOLT (16, 25, AND 32 C.P.).

	Association. Retail price list.	Association. Net price quoted.	Non-Association. A.	B.	C.	D.	E.
1914 ...	2/2	1/4·64	1/-	1/-	1/3·6	—	—
1915 ...	2/2	1/5·7	1/-	1/-	1/1	—	—
1916 ...	2/2	1/3·37	1/-	0/11·05	1/1	—	—
1917 ...	2/6	1/2·28	1/-	0/11·05	0/10·5	—	—
1918 ...	3/-	2/1·2	—	1/9 6	—	—	—
1919 ...	3/-	1/11·68	—	1/9¼	1/9	—	—
Jan. 1920	3/-	1/11·68	—	1/9¼	1/9	1/9	1/7 44

The discrepancies between these prices and the minimum figures given in the preceding table are accounted for by the difference in the volume of purchases by a corporation, though large, as compared with those of a factor, and the consequent differences in discounts allowed. From the two tables we draw the following inferences:—

(*a*) That non-Association firms, although their output is in general smaller than that of the Association firms, are able to sell lamps at a lower price than Association firms, and still make a satisfactory profit on their manufacture.

(*b*) That because of the standard price policy the public was compelled to pay the same price for non-Association and Association lamps, the whole price-advantage of the former (which to the factor was 9¼d. in 1912 and 2¾d. in recent years) being denied to the householder.

We desire also to call attention to the following points:—

(*c*) That in 1912 lamps bought by the British householder at 2s. 6d. were sold by the manufacturers (presumably at a manufacturing profit) to large factors at 9d.

(*d*) That between September, 1913, and April, 1917, lamps bought by the British householder at 2s. 2d. were sold by the manufacturers (presumably at a manufacturing profit) at 6d. for export.

(*e*) That at the present time lamps bought by the British householder at 3s. are sold by the manufacturers (presumably at a manufacturing profit) at 1s. 4½d. for export.

Since the beginning of the war the price to the public of the standard vacuum lamp has been increased by about 26 per cent. As the general retail price level of necessaries has risen during the same period by 125 per cent., it follows that the price of electric lamps has been advanced much less than the price of commodities generally. Two considerations are to be taken into account here: one is that immoderate profits were being made on the manufacture of electric lamps in the period immediately preceding the war. A reduction in the price of lamps was already overdue, and, we are told, was projected at that time. The other is that in consequence of improvements in the technique of manufacture, economies in the cost of production had become possible, and the price of lamps was simultaneously falling in some other countries. But allowing in full for these considerations it must be agreed that had the price of lamps been uncontrolled by any Association, or had the Association so desired, a much higher retail price could have easily been obtained. In this connection it is important to remember that the prices fixed by the Association are maximum as well as minimum, and it is just as much a breach of agreement to sell lamps above the fixed price as to sell below it. We are satisfied that during some periods of the war, in view of the limitations of imports the Association had a stabilising influence on electric lamp prices in the United Kingdom. Our unqualified testimony thereto does not prevent our recognising that just as the Association in periods of scarcity prevented prices rising as much as they otherwise might have done, it could equally effectively in time of plenty prevent them from falling as far as they ought.

8. We have endeavoured to ascertain the production cost of electric lamps as delivered from the factory, and to arrive at the profit made by lamp manufacturers either per lamp or as a percentage upon capital sunk in the business. Owing to the fact that the leading lamp manufacturers in the Association are large concerns producing electrical apparatus of all kinds, lamps being but one minor item in their total output, we cannot determine from their balance sheets what rate of profit is made upon that section of the business which is devoted to lamp manufacture. We have, however, sought

information as to the actual costs of manufacture of electric lamps, and figures have been given to us by representatives of associated and non-associated firms from which we learn that the present-day average factory cost of lamps which are sold to the public at 3s. and 3s. 6d. varies from 9d. to 1s. 4d. per lamp, according to factory, process, and material used. The Electric Lamp Manufacturers' Association has furnished us with figures, which we summarise as follows:—

Four Association Firms.

(Standard Vacuum Type Lamp with drawn-wire Filaments.)

	1913. (pence)	1919. (pence)
Labour cost	1.9	4.0
Materials cost	3.6	9.9
Overhead factory charges	1.9	2.2
Selling charges	3.7	5.1
Total factory and selling costs	11.1	21.2
Average price received by manufacturers	20.6	25.9
Manufacturers' average profit per lamp ...	9.5	4.7

We have not thought it necessary to check these figures by requiring an independent cost-accountancy of the books and records of these firms. From them one matter to which we have already called attention—the inordinate profits enjoyed by lamp manufacturers in the years immediately prior to the war may be clearly seen. In the year 1913 four manufacturers made on the average 9¼d. profit on lamps which cost just over 11d. to produce and sell, a profit of over 86 per cent. on gross cost. Last year the costs of producing and selling appear to have risen comparatively more than the price received, and the profit, according to these figures, was then only 4¾d. on a lamp costing 1s. 9¼d. to produce and sell.

We remark, however, that according to the first table in paragraph 7, at least one Association firm quoted prices of 1s. 4¾d. and 1s. 7¼d. in 1919 for lamps for export, which is lower than the production cost given in the table immediately above. Even on those figures we think it desirable to point out that lamps sold at 3s. and 3s. 6d. cost only 1s. 4d. to manufacture and that the remaining 1s. 8d. or 2s. 2d. was absorbed in selling expenses incurred by the makers and in margins absorbed by the distributing trade. We think it worth while to record, moreover, that three non-Association manufacturers have given us figures which indicate that their cost of material rose only 100 per cent. in the period covered by the Association's statement.

We are disposed to conclude that, taking associated and non-associated firms together, the manufacturers' average margin of selling price over factory cost may be taken as being about 1s. per lamp. Some part of this must be earmarked for advertising, selling expenses, research, patent fees or royalties, and reserves against patent litigation; the rest is profit. We consider that the 5d. per lamp allowed by the Association for selling charges as shown above is more than is necessary in view of the fact that the bulk of their sales are to the trade.

(To be concluded.)

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electricians v. Plumbers.

I thought it might interest your readers and the trade generally to know that Burnley and district E.T.U. members are taking the same stand as Blackburn, viz.: "No installation erected by plumbers or non-unionists will be coupled to Corporation mains." A notice in the local Press from next Saturday's issue will be inserted warning electrical contractors, users, and prospective users of electricity of these instructions to our members who are plumber-jointers for Burnley Corporation. It is about time the scandal of every Tom, Dick, and Harry doing electric installation work was put a stop to. The rule comes into force May 1st, 1919.

In this district electrical contractors are as common as chip and tripe shops, and some of the work—well! ——

Albert J. Cutler.

Padiham.
March 22nd, 1920.

Situations Vacant.

I should like to express my feelings with "Pro Bono Publico," as to the prevailing custom of box numbers; if firms do not wish to give their full name, you certainly, Sir, ought to insist on an indication letter being inserted so that applicants do not have to write you on every occasion they insert an advertisement. One firm I know of (not a thousand miles from Euston Road) are always inserting advertisements, and are still looking for their superman. Also, why do you allow duplicate advertisements as in this week's issue—Box 9495-6 from the same firm?

If you can see your way to give us employés some consideration we shall be greatly obliged.

S. E. Brown.

Wallsend.
March 23rd, 1920.

[Advertisers in the Press purchase space in which they can put what they please, provided that they do not thereby cause injury to others by libel, fraud, &c. Indications such as our correspondent suggests would involve an interference with this privilege. Our advertising department undertakes to withhold letters if the writers name firms to whom they are not to be forwarded.—Eds. Elec. Rev.]

In the last issue of the Review I note, and quite endorse, the remarks of "Pro Bono Publico" re "Situations Vacant."

All applicants for jobs, advertised under box numbers, may take it for granted that there is something very fishy, or in more vulgar language, stinks, when the advertiser does not put his name to the advertisement.

I would advise all engineers to treat such advertisements as they would a mad dog, viz., leave them alone, and let the advertiser stew in his own juice.

J. E. Ellis,
Borough Electrical Engineer.

Morley.
March 22nd, 1920.

University College, London, War Memorial.

We trust you will give us the hospitality of your columns to call the attention of former students of University College and University College Hospital, London, to the memorial we are endeavouring to raise to college and hospital men who fell in the war. Owing to the many changes that have taken place during and since the war, our address-list is not complete. It will be of great assistance to us if all members of the College who have not already received our appeal will send postcards with their names and addresses and dates of student years to the hon. secretary. We shall then be very glad to send them full particulars of our war memorial scheme. We hope we may rely on the support of all students, past and present.

Lawrence Solomon, Hon. Secretary.
Gregory Foster, Chairman.
G. Blacker, Vice-Chairman.

University College, London.
March 25th, 1920.

NOTES FROM CANADA.

(From Our Special Correspondent.)

Canada has before her to-day a question of very great importance in the form of the proposal to canalise the St. Lawrence River from Montreal to Kingston, where Lake Ontario becomes the river, a distance of some 170 miles, about 70 of which is the international portion of the river, the remainder being entirely in Canadian territory.

This subject is being considered at present by the International Joint Commission, before which a series of public hearings is to be held during the next few months in various localities likely to be directly concerned in this matter; one such hearing was held in Buffalo recently.

Being an international problem, the Governments of both this country and the United States are naturally interested in it.

It may be said that the proposal is to build several dams at suitable points on this great river so as to turn it into a canal which will enable ocean-going steamers to come right up into the great lakes, in this way such vessels could go straight from ports in other countries right into the heart of the Dominion, even so far as the Twin Cities, Port Arthur and Fort William, at the extreme end of Lake Superior. Montreal is the present terminus for ocean steamers.

So much for navigation. In addition the proposal includes the development of about 2,000,000 h.p., as it is stated that approximately this amount could be made available if the scheme be properly carried out so as to take care of both navigation and power.

The Commission referred to above has been charged by the two Governments concerned with the duty of hearing arguments for and against this great scheme, and there is every indication that there will be a real fight between the opposing interests. On the one side are Ontario and the great grain-growing Provinces of the West, together with the Western States bordering the southern shores of the Great Lakes, and on the other are the City of Montreal, New York State, the great railway interests on both sides of the international boundary and the powerful coal companies located in those parts of the United States which supply Canada with a large part of her coal.

To anyone over here the reasons for the contending views held by the people of the various Provinces and States, and by the several bodies named, are readily apparent, but some little explanation seems necessary for the benefit of readers at home.

Ontario will benefit both from increased shipping facilities for existing and possible future ports, and from the immense amount of power, over 1,000,000 H.P., that would be her share of the total available; the increase in general trade, in population, and in industrial activity, that would result if such a scheme can be carried to a successful commercial conclusion, is almost beyond calculation.

The Western Provinces and the Western States are deeply interested because of the readiness with which the immense grain produce of those regions could be transported to other lands at rates much lower than is possible now with rail transportation and double handling. The Canadian Provinces are further concerned because such navigational facilities as would be afforded would enable coal to be delivered cheaply from Nova Scotia to many lake ports, thus rendering the Dominion far less dependent on United States supplies, and incidentally benefiting Nova Scotia, too, by providing a large new market for her coal.

Montreal is opposed to the project because she fears that her importance as a port is almost certain to be considerably diminished; New York State is opposed to it because a great deal of the grain from the West is shipped along the barge canal in that State, and the people there are afraid that they will lose a large portion of the existing traffic along this canal. The railway companies naturally feel that a very large and profitable traffic may almost disappear from their lines, while the coal companies realise that their shipments to Canada will be very greatly reduced.

To a very large portion of Eastern Canada the coal problem is a very serious one, as Ontario and Quebec are practically without any supplies of their own, and at present Ontario is wholly dependent on the United States. Already that country is beginning to inquire for how much longer she can afford to ship coal into Canada, and the period appears to be not much more than a century; a large part of the population of Ontario is, therefore, absolutely at the mercy of the United States for its very existence, and unless means of getting coal at reasonable rates from Nova Scotia are provided (as by some such scheme as that referred to above) it is difficult to see how Ontario can, say, 25 years from now, supply fuel to any considerable population, such as 40 or 50 million people, because it is unlikely, even if the United States does not actually reduce her exports of coal to this country, that that country will allow any great increase in such exportations to take place, hence people in Ontario who could not obtain sufficient supplies of fuel in the winter would either have to seek a warmer clime, or go to a region where the fuel supplies were ample—or perish.

With reference to the proposed power development which forms an essential part of this great St. Lawrence scheme, it has been roughly estimated that the sale of power will pay for the entire undertaking, both as regards navigation and power. That during the next few years it will be possible to dispose of so large a quantity of electrical energy as two million H.P. is hardly to be doubted, in view of the ever increasing demands for power that are being made each year on this continent.

TRANSFORMERS FOR ELECTRIC FURNACES.

At Birmingham, on February 25th, Mr. J. L. Thompson's paper (an abstract of which appeared in our issue of January 30th last) was read and discussed before the South Midland Centre of the I.E.E.

Major A. M. Taylor pointed out that nowhere in the paper was the use of three-phase transformers contemplated. Presumably the difficulties in their construction were too great to be faced, but surely from the central station engineer's point of view, a considerable amount of unbalancing of the mains was introduced thereby. The author had brought out very clearly the losses introduced in the core clamping plates, and inferred that the core transformer was on that account not so good as the shell transformer. This leakage flux could probably be considerably reduced if the coils were subdivided into narrower and deeper coils, thus giving the leakage paths further to travel. This would also get over the difficulty of the secondary coils sharing the load unequally when certain of the primary coils were cut out of circuit. No doubt the difficulty was that a certain amount of reactance was wanted in the transformer, but such reactance could be obtained separately outside the transformer, and it would seem as though this would be the best arrangement.

Mr. M. Kahn thought the paper gave a very instructive comparison of the core and shell types of transformers as applied to furnace work. There were advantages and disadvantages in either type, which counterbalanced one another more or less, although it appeared that the shell type was easier to build and arrange than the core type. A very important consideration in connection with the choice of the type from the user's point of view, on this particular class of transformer, was the question of repairs. If a coil of a shell type transformer broke down, the whole core had to be rebuilt, whilst in the core type only the top yoke had to be removed. This advantage might decide the question, particularly on the smaller sizes, where some of the considerations set out in the paper, for example, the influence of the connections between coils and the bringing out of the leads, did not offer great difficulties on either type of transformer. With transformers of small outputs it was possible to avoid connections between various sections of L.T. coils in parallel by arranging the L.T. winding in the form of a wide copper sheet which extended over the whole length of core, and was wrapped round the iron in a spiral. It was essential with this construction to avoid uneven distribution of the flux by arranging the tappings in the middle of the core, otherwise considerable losses would occur in the copper sheet.

Mr. H. S. Holbrook said that with transformers and boosters arranged in the manner shown by the author, it appeared that the hot oil rising from the transformer would tend to overheat the booster windings.

Mr. F. Forrest thought it most essential that all large oil-cooled transformers should be provided by the manufacturer with an indicating thermometer or temperature detector, and that such an instrument seemed especially necessary in the case of transformers for furnace work which were subjected to severe shore circuits. These thermometers should be included whether they were called for or not by the purchaser, and it was the manufacturer's business to indicate to the buyer how essential it was that he should know the working temperature of the transformer windings.

Mr. W. Perry said the author had given a well-balanced comparison between the shell and core types of transformer for furnace work. By using a two-legged rectangular core mounted horizontally in the tank, the L.T. leads could be made of practically the same length, and without joints, as in the case of the shell type, the ventilating ducts between the coils would be in the same direction as the natural flow of oil, and could be insulated on the same method as the shell type. There would also be plenty of room to bring up the H.T. leads without congestion. There was the further advantage that the economic proportions of copper and iron could be reasonably obtained, also a butt joint in the core could easily be used to facilitate repairs. With regard to the H.T. terminals, he was of opinion that they should be brought through corrugated porcelains, and that in exceptionally dirty conditions they should have at least one petticoat to obviate the possibility of a flashover. With regard to the different power factors at different periods of the run, he said that between the melting period and the molten period there was a difference of 16.5 per cent. in the reactance of the circuit, which difference must originate in the bath. Was it correct, therefore, to assume that it was due to the molten steel having lost its magnetic properties. Most transformer manufacturers would agree with the author's conclusions that the most reliable transformer was one without any tappings on the H.T. side. Current control could be obtained on the L.T. side by the use of variable chokers, which were made similar to transformers. A fine wire winding of equal ampere turns to the main current winding was used, and shorted or opened automatically by a standard contactor. The choker would be of a rating of about 20 per cent. of the output of the main transformer, and would be somewhat expensive, but very reliable.

The Ministry of Transport.—A supplementary vote for £181,061 for salaries and expenses of the above Ministry for the half-year ending March 31st, was passed by the House of Commons on March 10th. Of the total, the salary list accounts for no less than £171,861, or at the rate of £343,722 per annum. The following figures show, according to the daily Press, how the staff has grown: December, 1919, 449; March, 1920, 774, an increase of 325. The list of the salaries paid to its leading members is said to be as under: Transport Minister (Sir E. Geddes), £5,000; chairman of the Rates Advisory Committee, £5,000; secretary and solicitor, £3,750; assistant secretary and solicitor, £1,500; parliamentary secretary, £1,500; director-general of civil engineering, £3,000; deputy-director ditto, £2,500; three chief engineers (each), £2,000; director-general of traffic, £3,000; three directors (each), £1,200; director-general of mechanical engineering, £2,500; two directors (each), £1,200; consulting mechanical engineer, £2,500; director-general of finance, £2,500; secretary, £1,200; director-general of roads, £2,300; chief engineer, £1,500; assistant secretary, £1,200; director-general of transport, Ireland, £2,100; two subordinate directors (each), £1,200; director-general of public safety, £2,000; secretary, £1,200; director-general of development, £2,070; secretary, £1,200; commissioner of light railways, £1,000. Twenty-eight officials receive an average of over £2,000 a year. The railway companies have been drawn on considerably for the Minister's staff. Last December there were 55 members of the staff who had previously been in the service of the railways, and 14 who were formerly employed by local authorities. It should be noted that the above figures do not include the salaries of the Electricity Commissioners nor the expenses of their department.

BUSINESS NOTES.

An Offer from Algeria.—Mr. P. H. Debelfort, the chief engineer of the Mascara (Algeria) electricity works, informs us that he is willing to act as an intermediary between English producers and French customers in Algeria.

Transit of Goods for the Serb, Croat and Slovene State.—The Department of Overseas Trade understands that the Roumanian Government has given instructions to allow the free transit of all goods destined for the Serb, Croat and Slovene State which arrive at Danubian ports. It is, however, essential that the ship's manifests, bills of lading, &c., as well as the packages themselves, should be clearly marked "Transit pour la Serbie," as otherwise they are liable to detention by the Roumanian Customs Authorities at the port of arrival.

Socials.—The Ipswich staff of the Electrical Department of Messrs. Mann, Egerton & Co., Ltd., held a Bohemian concert on Saturday evening, March 20th. Over 100 members of the staff and friends were present at the Great White Horse, where the event was held. Mr. C. Lill, the manager of the department, presided, and he was supported in the vice-chair by Mr. A. Fisher. During the war—from 1914 to the Armistice—the company was engaged building aeroplanes and carrying out electrical installations at many important aerodromes. Since the Armistice, the return to pre-war work has been occupying everybody's attention: that work consists chiefly of country house lighting and factory equipments. The social gatherings, such as that alluded to above, are being arranged with the hope of creating a good spirit between the technical, clerical and "working" staffs.

A whist drive and dance organised by the Electrical Trades Union in Blackpool Tower was attended by considerably over 1,000 people. The prizes for the whist drive were presented by the Mayoress (Mrs. E. H. Howe).

Book Notices.—Scientific Paper, No. 364, of the U.S. Bureau of Standards, "Relation of Voltage of Dry Cells to Hydrogen-Ion Concentration." Washington: Government Printing Office. Price 5 cents. Report of Investigations into Voltage Variation and Polarisation of Dry Cells.

"The Practical Engineer Electrical Pocket-Book and Diary, 1920." (592 pp.). London: The Technical Publishing Co., Ltd. Price, cloth, 1s. 6d. net; best binding, 2s. net. This edition, the twenty-first, has been thoroughly revised and brought up to date, and many additional tables and notes have been introduced. The Electric Furnaces and Pyrometry sections have been entirely re-written.

"Studies in Elementary Physics." By E. Blake. Pp. vi + 176, 43 figs. Price 5s. net. "Wireless Transmission of Photographs." By M. J. Martin. Second edition, pp. xv + 140, 77 figs. Price 5s. net. "Wireless Telegraphy and Telephony." By H. M. Dowsett. Pp. xxix + 331, figs. 305. Price 9s. net. London: The Wireless Press, Ltd.

Liquidations and Dissolutions.—Kendall & Gent, Ltd.—Winding up voluntarily for reconstruction purposes. Liquidator, Mr. T. W. Wright, 13, St. Ann St., Manchester. Meeting of creditors, April 9th, at Manchester. Claims must be sent to the liquidator by April 23rd.

Britannia Lamp and Accessories Co., Ltd.—Winding up voluntarily. Liquidator, Mr. R. L. Tayler, 24, Coleman Street, E.C. 2. Meeting of creditors, April 6th.

Electric Train Lighting Syndicate, Ltd.—Winding up voluntarily. Messrs. Day & Yewdall, solicitors, 4, Central Bank Chambers, Leeds.

Tong, Nutter & Sons, electrical engineers, manufacturers, and merchants 41, The Side, Newcastle-on-Tyne.—Mr. A. S. Tong and Mr. P. Nutter have dissolved partnership. Mr. P. Nutter will attend to debts and continue the business.

Auction Sale.—By direction of the Disposal Board, Ministry of Munitions, Messrs. J. J. Greaves & Sons will sell by auction, on April 28th, at the Cyclops Works of Messrs. Cammell, Laird & Co., Sheffield, machinery and plant, including electric overhead travelling cranes, centrifugal pumps, electric motors, electrical fittings, office fittings, &c. Full particulars are given in our advertisement pages to-day.

Bankruptcy Proceedings.—F. Mitchell (F. Mitchell and Co.), electrical engineer, Manchester.—Application for debtor's discharge will be heard at Manchester on April 27th.

W. H. Howard (Holborn Electrical Co.), electrical engineer, 5, Featherstone Buildings, Holborn, W.C., and Finsbury Park.—Discharge suspended for two years from February 27th, 1920.

Catalogues and Lists.—Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C. 2.—Illustrated Pamphlet, No. 284, the "Xcel" electric utility cooker. Other agents for this British product are: Messrs. Siemens Bros., Down & Davies, the Electrical Supplies, Berry's Electric Co., and the Sun Electrical Co.

The Consolidated Pneumatic Tool Co., Ltd., Egyptian House, 170, Piccadilly, W. 1.—Catalogue No. 41. A comprehensive list of pneumatic tools covering drills, hammers, portable mine-hoists, &c., and giving illustrations and complete details.

Trade Announcements.—Mr. Fernand Espir announces that, as from January 1st, 1920, he has taken into partnership his son, Mr. H. Espir, and his brother, Mr. J. Espir, the style of the firm remaining unchanged.

Messrs. Percy Huddleston & Co.'s London telephone number has been changed to "Clerkenwell 1094."

Messrs. Connolly's Blackley, Ltd., have removed their London sales office to 46 and 47, Finsbury Square, E.C. 3. Mr. O. H. Bishop will continue in charge. New telephone number, "London Wall 7188."

Electric Motor Prices.—At a sale of engineering plant and machinery under the direction of the Disposal Board, Ministry of Munitions, at La Bassée Shell Factory, Glasgow, among the best prices realised were—A 40-B.H.P. electric motor, £205; and two 7-B.H.P. electric motors, £103 each.

Copper Prices.—Messrs. F. Smith & Co. report (March 29th):—Electrolytic bars, sheets, wire rods, H.C. wire, no change.

Messrs. James & Shakespeare report (March 29th):—Copper bars (best selected), sheet and rod, £166, a decrease of £2; English pig lead, £43, £3 reduction on last week's prices.

Strike.—On Friday last 350 workers at the Enfield Ediswan Cable Works downed tools.

German Transmarine Electricity Works.—With reference to the leaderette on this subject, appearing on an earlier page of this issue, the *Daily Mail* Madrid correspondent says:—"The Deutsche Ubersee Elektrizitäts Gesellschaft, with big interests in South America, especially Buenos Ayres and Santiago, is turning itself into a Spanish concern. The German company has a nominal capital (each share of 1,000 marks) of 260,000,000 marks [at par £13,000,000]. This is to be converted into Spanish capital (each share being of 500 pesetas) of 300,000,000 pesetas (at present rate, £15,000,000). Other German companies are following suit."

Electric Welding Demonstration.—On Saturday last, the A 1 Manufacturing Co., of Sunbridge Road, Bradford, gave a demonstration of the capabilities of some of their welding appliances. Particulars will appear in our next issue.

Train Lighting.—We learn that the 100 new suburban railway carriages, which are now being built for the New South Wales Government Railways in Sydney, are to be fitted with Stone's system of electric lighting, comprising Liliput dynamos, Pegoud switches and accumulators.

For Sale.—Aberystwyth Town Council invites tenders for a 125-H.P. Daimler petrol engine. For particulars see this issue.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British trademarks in connection with productions associated with the electrical industries:—

Treva. No. 397,128. Class 8. Electrical contacts, terminals, parts, fittings, lamps, fusible cut-outs, sparking plugs, and switches. No. 397,129. Class 14. Electrical fittings made of precious metals or imitations thereof. No. 397,130. Class 16. Electrical insulators, parts, and fittings, made of porcelain or earthenware. No. 397,131. Class 20. Electrical detonators and fuses (explosive). No. 397,132. Class 40. Electrical insulators, parts, and fittings, made of ebonite or like substances manufactured from india-rubber or gutta-percha. No. 397,133. Class 50. Electrical insulating materials, parts, and fittings of wood, bone, ivory, or other substances. Trevelyan & Co., 155, Bracebridge Street, Birmingham. November 12th, 1919.

The giant that lives in a box (lettering combined with two different designs), Nos. 398,178 and 398,179. Class 8. Electric accumulators and parts thereof. The Chloride Electrical Storage Co., Ltd., Clifton Junction, near Manchester.

Philco. No. 398,928. Class 40. Goods manufactured from india-rubber and gutta-percha. Philadelphia Storage Battery Co., Philadelphia, U.S.A., December 30th, 1919.

Fyrac. No. 398,471. Class 13. All goods in Class 13. National Spark Plug Co., 214-216, East State Street, Rockford, Ill., U.S.A., December 16th, 1919.

Faem. No. 397,689. Class 17. Electric and pneumatic bell systems, &c. Mercantile Engineers & Founders, Ltd., 224, St. Vincent Street, Glasgow. November 27th, 1919.

Electrol. No. 399,046. Class 1. A chemical compound serving as an electrolyte, and a charging compound for use in connection with electric batteries. Henry Edmunds, Parliament Mansions, Victoria Street, Westminster, S.W., January 2nd, 1920.

Hermetic. No. 384,723. Class 50. Vulcanised fibre, electrical insulating tapes, &c. The Self Sealing Rubber Co., Ltd., Hermetic Works, Ryland Street, Birmingham, August 13th, 1918.

P.N. (initial letters embodied in design). No. 390,006. Class 6. Electric generators and parts of same, &c. The Pyle-National Co., 1334, Kostner Avenue, Chicago, U.S.A., April 9th, 1919.

A.E.G. (letters combined with design). No. 356,202. Class 8. Electric cables, batteries, induction coils, resistances, switchboards, and meters. Allgemeine Electricitats Gesellschaft, 2-4, Friedrich Karl Ufer, Berlin, Germany, November 8th, 1913.

Walger (lettering combined with design). No. 389,905. Class 40. Connection insulators, and insulating preparations. Edwin Arthur Walshaw, Glasgow Road, Bolton, Ont., Canada, April 7th, 1919.

Hardite. No. 398,730. Class 50. Compositions used for electrical insulation purposes and battery cases, bases for electrical apparatus, &c. Frederick James Harden, 41, Norroy Road, Putney, S.W., December 22nd, 1919.

Spondite. No. 391,819. Class 50. Electric insulating materials, &c. British Cellulose & Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W., May 30th, 1919.

Spondonite. No. 391,817. Class 50. Electrical insulating materials. The British Cellulose & Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W., May 30th, 1919.

R.M.R. (initial letters embodied in design). No. 398,597. Class 5. Wire and metals used in the manufacture of radio telegraphic and electrical goods. No. 398,599. Class 13. Radio telegraphic and electrical goods of metal. No. 398,600. Class 16. Radio telegraphic and electrical goods of porcelain or earthenware. No. 398,601. Class 41. Radio telegraphic and electrical goods, being articles of furniture. No. 398,602. Goods made of wood or other material covered by Class 50 for use in radio telegraphy and electrical work. R. M. Radio, Ltd., 5, Chancery Lane, London, W.C., December 19th, 1919.

Trade with Argentina.—The Buenos Ayres correspondent of the *Chamber of Commerce Journal* says: "Provided only that the goods can be obtained, British importers in Argentina at the present moment are on velvet. Not only is there a benefit, which at the time of writing works out at about 40 per cent., on exchange, but there is also an unquestionable preference for British goods, a preference that is readily translated into pounds, shillings and pence. Argentine buyers to-day are willing to pay more for a proved British article than for new and untried goods from elsewhere, and this preference is particularly marked against many United States products. Both official departments and private buyers agree in this matter, and, while it is not right to say that the United States are losing their trade in this part of the world, it is no exaggeration to declare that they have lost, and are still losing, many golden opportunities."

Later the writer says: "American sellers of harvesting machinery were perhaps the first to see that it was not enough to dispose of a machine; it must also be kept running. To this end they had always available a number of capable men who could be sent anywhere at a moment's notice and who understood the job they were on blindfold. It is evident that this apparently unremunerative addition to selling charges is beneficial to the main interests of any big business which adopts it, and one or two of the large Argentine importing houses have adopted something similar on their own account, without, however, getting much support in the past from British manufacturers of machinery, either tools or plant. Its general adoption has, therefore, everything to recommend it, and when combined with co-operative salesmanship, it will unquestionably do much to push British export in one of its most valuable lines. Every smooth-running British machine is in itself a piece of propaganda, and when the man in charge of it is convinced of its virtues, and knows, moreover, that in any case of unforeseen difficulty or breakdown he is able to obtain speedy and expert assistance, its introduction paves the way for further purchases in the same quarter. It may not be out of place to point out that Germany had already begun to adopt similar tactics in regard to electrical plant and flour-milling machinery before the war; and with very satisfactory results, as may be gathered by conversation with any chief mechanic or engineer in charge of the various mills and electric light stations about the Republic, even when he does not happen to be of German birth or descent, as so frequently is the case."

LIGHTING AND POWER NOTES.

Accrington. — Industrial Supply. — Regarding the application of Messrs. Howard & Bullough, textile machinists, for an increased supply of power to their Charter Street Works, Accrington Electricity Committee has agreed upon a basis of charging for additional supply. The estimated cost of the necessary high-tension cable, switchgear, &c., is £2,000.

Aldershot. — Extensions. — The proposal to spend £21,550 on extensions led to criticism by members of the Council, who stated that the local private undertaking showed a profit of £1,017 during last year, while the municipal works showed a deficit of over £1,000. The proposed extensions include turbo-generators (£11,000), boilers (£3,500), and buildings (£6,500).

Alfreton. — Electricity Supply. — The Notts. and Derbyshire Power Co. has notified the local Town and Trade Association that it is willing to extend its mains from Ripley if sufficient revenue is assured. The cost of laying the mains would be from £1,000 to £1,200, and the company would expect a yearly revenue of £1,000. The comparative cost of electricity is half the present cost of gas, and the Association is supporting the scheme.

Beachley.—Tidal Power.—The cost of the scheme to erect a bridge over the Severn and a dam to harness the 40-ft. tide for the purpose of generating electricity, is stated to be between £8,000,000 and £9,000,000. The *Evening News* says the project is expected to be completed in about five years.

Birmingham.—New Power Station.—Owing to the slow delivery of steel-work for the construction of the new power station at Nechells, the building will not be ready for the reception of the plant in the estimated time. It was originally hoped to have the station running by October, but there seems every probability of another shortage of power during next winter.

Blackburn.—Proposed Linking-up.—The Corporation, in conjunction with Preston Corporation, is negotiating with the Electricity Commissioners upon the question of laying a main between the two undertakings.

Bolton.—Extensions.—The Electricity Committee has approved a scheme of extensions to the Back-o'-th'-Bank power station. The first stages are expected to cost £140,000, and the ultimate total expenditure will be £250,000.

Bradford.—New Plant.—A much-needed addition to the present plant, a 10,000-kw. turbo-generator, which has been on order for a considerable time, is expected to be installed at the Valley Road station within the next three months.

Canada.—Water Power.—The *Electrical News*, of Toronto, publishes some interesting information regarding the utilisation of Canadian water power for the generation of electricity. It is stated that, of an estimated available H.P. of 18,832,000, a total of nearly 2,400,000 H.P. is being developed. The Ontario Hydro-Electric Commission's undertaking at Chippawa (Niagara Falls) is to have an initial capacity of 200,000 H.P., with future extensions to bring it up to 500,000 H.P. The Government plants at Shawinigan and Grand Mere are to be raised from 330,000 to 600,000 H.P.

Continental.—Austria.—The *Economic Review* learns from a Continental source that the American Westinghouse Co. and other American industrial groups are considering the exploitation of the water power of the Austrian Alps.

France.—The movement for the centralisation of the supply of electric energy in the Paris district has extended to the South west of France. Various companies in the Lyons district have formed themselves into a company to supply electricity to Lyons and St. Etienne. The scheme consists in gradually replacing the present fuel stations by water power, and the linking-up of the South-east networks will enable the company to utilise the St. Etienne coalfield when reinforcement is needed. At the moment, 10 companies, producers or consumers of electricity, constitute the group: the Gaz et Electricité de Lyon; the Société Hydroélectrique de Lyon; the Société des Forges et Aciéries Paul Girod; the Société Lyonnaise des Forces Motrices de Jonage; the Société des Forces Motrices de la Tarentaise; the Société pour la Création et l'Utilisation des Forces Motrices de la Haute-Isère; the Société Force et Lumière; the Energie Electrique de la Loire et du Centre, &c. The energy distributed in the Lyons and St. Etienne district will total at the outset about 100,000 H.P., requiring some hundreds of tons of coal daily, and is insufficient for the needs of the district. Consequently, further calls on the Alps and on the Central Plateau will have to be made. The Truyère central station alone is able to supply 100 000 H.P. The first steps of the new company will be the setting-up of three 120,000-volt three-phase lines—one linking Lyons with Albertville; the second, Lyons to Bourg Saint-Maurice; the third, Lyons to a point to be fixed in the Tarantaise. The cost of each of these lines is estimated at 30,000,000 francs. The lines will converge on the same central station at Lyons, from whence power will be distributed. Application for sanction to the scheme on the ground of public utility is about to be made, and as the complementary generating works are under way, realisation of the scheme within two years at the latest is expected. The city of Lyons will be the chief consumer; the public lighting there is still by gas, and the demands for electric current for private lighting, heating, and motive power are beyond the existing three big companies' means to supply. Moreover, the Paris-Lyons-Mediterranean Railway, which has begun the electrification of the Cirloz-Modane line, and foresees that of the Lyons-Geneva and other mountain railways, will be an important consumer.—*L'Electricité.*

Owing to a dispute in the electrical industry of Verviers, the town and about 40 communes have been deprived of electric lighting and tramway services.

Chorley.—Electricity Supply.—The Town Clerk has reported regarding the obligation of the Lancashire Electric Power Co. to supply electricity in the borough under the Provisional Order of 1914, that the mains are still eight miles away, and a supply from any other existing authority does not at present appear practicable. It is proposed to discuss the whole matter with the Electricity Commissioners with a view to formulating a scheme.

Devonshire.—Joint Electricity Authority.—At a recent conference of representatives of municipal authorities, a deputation, consisting of delegates from Plymouth, Exeter, Torquay, and Barnstaple, was appointed to meet the Electricity Commissioners to discuss the formation of a Joint Electricity Authority for the county.

Dundee.—Delay in Extensions.—The progress of extensions to the electricity works is being held up by the difficulty in obtaining structural steel work.

Gold Coast.—Electricity Supply.—A Bill to make provision for the supply by private enterprise of electricity for lighting and other purposes has been introduced in the Gold Coast Legislative Council.—*West Africa.*

Hull.—Coal Shortage.—A deputation recently waited upon the Coal Controller to point out the great loss and inconvenience being caused by the shortage of fuel. It was stated that many large works had to be closed down at 4 o'clock in the afternoon, as it was impossible to supply them with power.

Lancaster.—Outbreak of Fire.—A fire recently occurred at the switchboard in the electricity works. Although it was soon extinguished the plant was temporarily put out of action.

Liverpool.—Mains Extensions.—The extension of over 50 cables has been approved, including a high-tension main to a factory at Aintree, at an estimated cost of £4,370, involving the erection of a sub-station costing £2,000. An extension from Longmoor Lane to Tazakerley will cost £8,100, and the sub-station £2,000.

Price Increase.—The charge for electricity for lighting purposes is to be increased by 25 per cent., as from January 1st.

Repayment of Costs.—The Tramways and Electric Power and Lighting Committee has decided to have a list compiled of the firms which have applied for the return of the amounts paid by them for the extension of mains, showing the cost of the work, the amount paid by these consumers, the amount proposed to be refunded, and the amount paid, or payable, in respect of the consumption of electrical energy by such firms, and the period of consumption. The list will be considered by the Committee at the next meeting.

London.—Hammersmith.—The original proposals for electricity extensions were submitted to the Electricity Commissioners, who recommended a much more comprehensive scheme to meet not only the needs of the borough, but also those of neighbouring undertakings. It is therefore proposed to install two 8,000 to 10,000-kw. turbo-generating sets at an estimated cost of £124,000, and three additional boilers, costing £45,000. Structural alterations to the boiler house will cost approximately £5,000.

Electricity Supply.—The Special Committee of the London County Council on London Electricity Supply has reported that, as the result of conferences with representatives of local authorities, it is clear that no satisfactory proposals can be put before the Electricity Commissioners without a general outline scheme dealing with the technical aspects of the subject. Mr J. H. Rider, of the firm of Messrs. Preece, Cardew & Rider, has, therefore, been engaged to investigate the matter and report thereon.

Lynton.—Price Increase.—The Electric Lighting Co. has increased the price of electricity for heating to 2½d. per unit up to 100 units per quarter, and for larger quantities to a flat rate of 1½d.

Nigeria.—Hydro-Electric Plant.—Messrs. Vickers are constructing a hydro-electric plant on the Kwall Falls of the N'Gel River for the Northern Nigeria Tin Mines. The power is obtained from a series of small falls over a length of 1¼ miles, which give a difference in level of 700 ft. The plant capacity is to be 1,500 kw., and power will be conveyed at a pressure of 22,000 volts to the mines (a distance of 15 miles), where it will be stepped down to a working pressure of 525 volts.

Plymouth.—Proposed Price Increase.—The Electricity and Street Lighting Committee recommends an increase of the charges for electricity for lighting by 1d. per unit, and for power by 5 per cent.

Skegness.—Proposed Electricity Supply.—Messrs. Handcock, Dykes & Trotter have prepared a scheme for the installation of electrical plant, &c., at an estimated cost of £19,580, including £2,240 for land and buildings. Before further steps are taken estimates are to be secured from other experts.

Worksop.—Proposed Extensions.—The electrical engineer recommends large extensions and additions to meet the consumers' increased demands. The proposals include the adoption of three-phase generation and a temporary bulk supply from the Manton Colliery, of the Wigan Coal and Iron Co., at a capital cost of £7,500, in order to meet consumers' demands. The matter has been referred to a Committee for consideration and report.

TRAMWAY AND RAILWAY NOTES.

Blackburn.—Increased Receipts.—The receipts of the Corporation tramways department for the past financial year amount to £116,964, an increase of £25,221 over 1919, and of £39,495 in 1918.

Burnley.—Wages.—Tramway employés on March 26th received the difference between their actual earnings for the last two weeks and their wages for the regulation 48 hours' week, in consequence of the Sunday stoppage through coal shortage.

The new tramway queue system came into force on March 27th, and all the unloading and embarking places in the Centre are now being labelled with indicators.

Continental.—Russia.—The municipal authorities of Petrograd have been empowered by the Executive Committee of the Soviet to introduce a system of free travel on the tramways.—*Economic Review.*

Exeter.—Additional Plant.—The city electrical engineer has been instructed to make inquiries regarding the purchase of a second-hand turbo-alternator of from 300 to 500-kw. capacity to augment the supply of power to the tramways.

Haslingden.—Fare Increase.—The Town Council has received the permission of the Ministry of Transport to increase all tramway fares on the borough routes by 50 per cent.

Ilford.—Railless Trolleys.—To meet the increased demand for transport facilities likely to follow the erection of thousands of new houses in the district, the Council is considering the advisability of commencing a system of railless trolley routes as the cheapest and most flexible form of transport.

Industrial Court Award.—Men and women employed in railway shops and generating stations are to receive an advance in wages of 1½d. an hour or 6s. a week, according to the system of payment in vogue. Piecework rates are advanced 15 per cent. These were the terms of an award made by the Industrial Court on March 24th.

Leigh (Lancs.).—Parliamentary Bill.—The Private Bill Committee of the House of Commons has informed the Corporation that its approval will be given to the Bill seeking powers to establish a motor omnibus service, if a clause is inserted preventing the Corporation competing with the South Lancashire Tramways Co. on the latter's existing routes.

London.—Underground Railway Fares.—As a result of representations by London M.P.'s, the "Tube-fares Bill" has been amended in two respects. First, it is agreed by the promoters that an increase in fares shall be made only to cover working expenses, efficient management, renewals, and a reasonable return upon capital; and, secondly, that workmen's return fares between any two stations shall not exceed the charge for the single journey, with a minimum fare of 3d.

Owing to the delay in paying arrears in respect of wage increases, the employés of the London Underground Railways threatened a strike at Easter, but the men have reconsidered their decision.

Traffic Authority.—The Committee appointed to advise the Minister of Transport on the London traffic problem, under the chairmanship of Mr. Kennedy Jones, M.P., has recommended, *inter alia*, the formation of a permanent authority, consisting of three members, to deal with all questions affecting traffic in the London area. The primary duties of such an authority would be to make a preliminary examination of all transport Bills, to examine schemes for traffic improvement, to study housing and town-planning schemes from the point of view of transport, to prepare a general development plan to which all new schemes should conform, and to consider all legislation proposed dealing with traffic and transport.

Railless Trolley Cars.—The London County Council intends to carry out experiments with railless trolley cars, as the cost of laying tracks has become unremunerative.

A tramway strike, to begin on April 4th, is threatened throughout the country, says the daily Press, "owing to the failure of the workers' side of the Joint Industrial Council for the tramway industry to induce the Council to grant a 44s. weekly increase on pre-war rates." This would mean a 10s. weekly increase on present wages. The resolution to tender notices was passed by the Transport Workers' Federation, and seven days' notice, ending at midnight on April 3rd, has been given by the tramways section of the United Vehicle Workers, who are affiliated with the Federation. The application for an increase was made on February 26th; the tramway authorities generally declared their inability to pay the increase demanded, but offered 2s. 6d., which was rejected.

Sunderland.—Year's Working.—The report of the directors of the Sunderland District Tramways for the year ended October 31st last states that after paying expenses and providing for depreciation, there was a balance for disposal of £24,385, including £1,195 brought forward from the previous year. From this was deducted £7,100 interest on the prior lien bonds and first mortgage debentures, £500 for sinking fund instalment, £8,000 for transfer to general reserve account, leaving a balance of £8,785. From this the directors proposed to pay dividends of 5 per cent. (less income-tax) on the first income bonds, the second income bonds, and the preference share capital. The sum of £1,208 was left to be carried forward. The traffic receipts have shown a substantial increase, but the working expenses have again been considerably higher.

TELEGRAPH AND TELEPHONE NOTES.

A New Exchange.—A new telephone exchange, to be known as Clerkenwell, was opened in Ironmonger Row, E.C. 1, on Saturday last. About 800 subscribers were transferred to the new exchange at 2 o'clock on Saturday afternoon. They were to be taken mainly from the London Wall, Holborn, Central, and City areas. A further 500 will be transferred on April 10th. The new exchange will serve the northern portion of the City, and by the end of the year it will have a capacity of 10,000 lines. The apparatus is of the manual type. A feature of the exchange will be an operating school accommodating 130 students. This makes London's seventy-fourth exchange, and by the end of the year three others will have been opened. At present there are about 155,000 subscribers in the London district, and others are being added at the rate of about 1,000 per week. Approximately 60,000 new subscribers have been connected since the armistice, and there are still half that number waiting for instruments.

Engineers for Dutch Colonies.—According to the *Schweiz. Bauzeitung*, of March 6th, the Dutch Government requires a fairly large number of electrical engineers for the Telegraph, Telephone, and Postal Services in the Dutch East Indies. As it is not possible to cover requirements in Holland, the Government wishes to engage young Swiss engineers holding the diploma of a technical college. In order to give applicants some idea of the conditions and duties of their employment, the (Dutch) Government arranged for a Colonial official, Herr Dom van Rombeck, Chief of the "Dutch East Indies Labour Department" at the Hague, to give a public lecture in Zurich, on March 8th, on the conditions in the Dutch East Indies, and in connection therewith to receive applications.

Why the Dutch Government should go to Switzerland for electrical engineers is not clear. Is not the war over yet? We have never heard that Swiss engineers have shown any special aptitude for telegraphy and telephony, subjects in which the British have always held their own.

Holland.—Owing to cable congestion between England and Holland, the Netherlands Chamber of Commerce in London has asked the Marconi Co. to report on the possibility of instituting a wireless telephone service. A licence would be necessary from each of the Governments concerned.

Italy.—Successful wireless telephonic conversation was carried on, last week, between Chelmsford (England) and Rome. According to Marconi officials, wireless conversation has been received clearly up to distances of 1,200 miles. Conversation has also been heard from a ship's station at a distance of 1,500 miles, but this was very faint.

Japan.—The estimates for wireless expansion in the Japanese Budget for the coming year do not, according to *Eastern Engineering*, cover the overhauling of the Funabashi Station, which must soon be taken in hand, but only provide for the replacement of the transmitting and receiving outfits. The apparatus is of the old German one-mast type. This is one of the three stations belonging to the Japanese Navy, the others being Hozan (Formosa), and the station at Sosebo, now in course of construction. The Navy will probably present a supplementary estimate to cover the construction and repair programme considered necessary.

Portugal.—The strike of telephone workers ended last week, and work was resumed.

Post Office Loss.—A White Paper issued on March 22nd, deals with the accounts of the Postal, Telegraph, and Telephone Services for the year ended March 31st, 1919, and shows deficit on both the telegraph and telephone departments. The net receipts of the two departments, including £5,456,573 put down as the value of services performed for other departments without remuneration, amounted to £16,193,289, while the expenditure aggregated £18,279,998. The ultimate result being a deficit on the telegraphs of £685,139, an increase of £128,809, and on the telephones a deficit of £36,261, against a net surplus of £355,468 in 1917-18. On the other hand, the postal services showed a surplus of £8,168,956, an increase on that of the previous year of £1,320,671.

Wireless Telephony.—Marconi's Wireless Telegraph Co. carried out successful demonstrations last week at Chelmsford in directing an aeroplane by means of wireless telephony.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—MELBOURNE.—April 12th. City Council. Two 2,000-KW. rotary converters; H.T. switchgear, 6,600 V.; D.C. switchgear, 600 V. (January 30th.)

PERTH.—May 3rd. Postmaster-General's Department. Insulators, bolts, brackets, &c. Schedule 673. (See this issue.)

April 14th. Postmaster-General's Department. Telegraph and telephone instruments and parts. Schedule 671. (See this issue.)

Bedwellty.—April 12th. Urban District Council. Electric wiring, fittings, &c. at Pengam and Aberbargoed. (March 26th.)

Belgium.—April 7th. The municipal authorities of Ixelles, Brussels. Supply of a quantity of armoured cable for low-tension distribution mains. Specifications may be obtained from the Maison Communale, Ixelles, for two francs.

April 6th. Municipal authorities of Chassepierre (Province of Luxenbourg). Tenders for a central electric lighting station in the town.

April 13th. Municipal authorities of Wevelghem. Supply and installation of a transformer sub-station of 150-KW. capacity. Particulars from and tenders to the Salle Communale, Wevelghem, Belgium.

Canterbury.—April 19th. Electricity Department. One 1,000-KW. three-phase turbo-alternator, surface condensing plant, two rotary converters, superheater, &c. (March 26th.)

Darlington.—April 19th. Electricity Department. One water-tube boiler. (See this issue.)

Edinburgh.—April 26th. Electricity Supply Department. E.H.T. paper-insulated lead-covered cables. (See this issue.)

Eastbourne.—April 16th. Electricity Department. Supply and erection of one water cooling tower. (March 26th.)

Great Yarmouth.—April 16th. Electricity Department. One 2,000-KW. turbo-alternator, one 750-KW. rotary converter and transformer, and one 750-KW. frequency changer. (March 19th.)

Lincoln.—April 8th. Electricity Department. Pipework, and motor-generator and switchgear for St. Swithin's power station. (March 5th.)

London.—SHOREDITCH.—Electricity Supply Department. Water-tube boiler, 5,000-KW. turbo-alternator, E.H.T. and D.C. switchgear. (March 19th.)

Margate.—April 15th. Town Council. Electric light installation, pavilion and winter gardens. Mr. J. E. Saxby, Manager.

Peterborough.—Electricity Department. 1,000-KW. turbo-alternator with condenser and pipe work, switchgear, 500-KW. rotary converter, superheaters, induced draught fan, two sets forced draught furnaces, foundations and builders' work, and H.T. cables. (March 19th.)

South Africa.—April 24th. Oudtshoorn Municipality. Time for receipt of tenders extended from March 24th to April 24th.

Tasmania.—LAUNCESTON.—June 7th. City Council. One 1,000-K.V.A. hydro turbo-alternator, with switchgear. City Electrical Engineer, Town Hall, Launceston.

CLOSED.

Accrington.—Electricity Committee. Accepted:—
Alterations to crane, £330.—J. Spencer & Co.

Australia.—SYDNEY.—City Council. Accepted.

4 miles 7/16 H.D. bare-copper cable	1s. 7¼d. lb.	W. G. Watson & Co., Ltd.
8 miles 7/14 " " "	1s. 8¼d. lb.	F. S. Lee.
4 miles 19/16 " " "	£430	F. S. Lee.
20 miles 7/18 " " "	1s. 9¼d. lb.	F. S. Lee.
8 miles 7/14 " " "	£468	W. Adams, Ltd.
10 miles 7/20 double-braided aerial cable	£195	Lawrence & Hansen Elec. Co., Ltd.

Two sets of front headers with water boxes for economisers; one set of back headers with water box, £2,437, Babcock & Wilcox, Ltd.
9,000 yd. ·15 sq. in. three-core 5,000 v. lead-covered H.T. cable, £6,884; 5,000 yd. ·4 sq. in. three-core 10,000 v. lead-covered H.T. cable, £3,562; 10,000 yd. ·15 sq. in. three-core 10,000 v. lead-covered H.T. cable, £8,896, Siemens Bros., Ltd. *Tenders.*

London.—STEPNEY.—Electricity Committee. Accepted:
3,000 tons West Cannock nuts, 41s. 4d. per ton; 2,000 tons ditto, 2 in. nutty slack, 35s. 10d. ton; 1,000 tons Tamworth, 1½ in. nutty slack, 37s. 6d. ton.

Switchgear for Whitechapel and Mile End sub-stations:—

A. Reyrolle & Co.	£7,761	Sub-station type (recommended).
Ditto (alternative)	8,086	
General Electric Co., Ltd.	7,785	
Bertram Thomas	8,026	
Switchgear & Cowans	8,026	
Park Royal Engineering Works, Ltd.	9,158	
Brit. Thomson-Houston Co., Ltd.	9,646	
New Switchgear Construction Co., Ltd.	9,910	
Edison Swan Electric Co., Ltd.	incomplete	

24 steel tubular electric standards for street lighting, £342, British Mannesmann Tube Co., Ltd. (Accepted.)
Additional supply 2½ miles of feeder cable, for the Limehouse and Whitechapel stations, £4,349. Henley's Telegraph Works Co., Ltd. (Accepted.)

House service cable:—

Henley's Telegraph Works Co., Ltd. (recom.)	**£385**
British Insulated and Helsby Cables, Ltd.	390
W. T. Glover & Co., Ltd.	442

¼ mile of earthenware pipes, and ¼ mile of troughs and covers.

Sutton & Co. (recom.)	**£215**
Siemens Bros. & Co., Ltd.	238
Henley's Telegraph Works Co., Ltd.	264

ST. PANCRAS.—Highways, Sewers and Public Works Committee. Recommended:—
Mossay & Co., Ltd.—Two 3½-ton "Orwell" electric motor wagons, with interchangeable cylindrical water-tank bodies, £1,613 each, including extras.
Lacre Motor Car Co., Ltd.—Two motor road-sweeping machines, £650 each.

FORTHCOMING EVENTS.

Association of Engineering and Shipbuilding Draughtsmen.—Thursday, April 8th. At the University, Liverpool. At 7.30 p.m. Lecture on "Design of a 40-ton Titan Crane," by Messrs. P. A. Arbeny and H. W. Mellor. At the Grammar School, Chesterfield. At 7.30 p.m. Lecture on "The Destructive Distillation of Coal," by Mr. E. Nicholson.

Institution of Electrical Engineers (Western Centre).—Monday, April 12th. At the South Wales Institute of Engineers, Cardiff. At 7 p.m. Lecture on "Thermionic Valves," by Prof. E. Bacon.

NOTES.

New Fire-Damp Indicator.—A new fire-damp indicator, the invention of an English electrical engineer, is said to have passed all tests, and should, in conjunction with the electric lamp, materially contribute to the safety of life in mines. According to the *Sheffield Independent* the instrument only occupies a space of 2 in. by 2 in., and weighs less than 8 oz. It is strongly made, and is unaffected by complete immersion in water; it can be incorporated in any electric lamp. The device, it is claimed, is capable of recording the percentage of fire-damp present in the atmosphere down to a quarter of 1 per cent.

Japanning Ovens.—A recent issue of the *American Machinist* contains some useful information regarding electrically-heated japanning ovens. The system described is that adopted by an American typewriter manufacturing company, and consists of a battery of six ovens, four of which are 7 ft. 5 in. high, 7 ft. 1 in. deep and 6 ft. 2 in. wide, while the other two are slightly smaller. The heating load of each oven is 27 KW. The heating units are compact, and as their maximum temperature is relatively low (400° F.) risk of burning out and causing fires or explosions is reduced to a negligible point. During their life of four years, these ovens have proved eminently satisfactory, and the fuel cost compares very favourably with gas-heated ovens, which circumstance, combined with the fact that the capacity of the electric oven is considerably above that of the other type, proves without doubt the soundness of employing electricity for this class of work. Figures given in the article show that the electric oven has a capacity of 360 frames, against 180 in the case of the gas oven, and while the fuel cost per day in the case of the latter is $5·78, that of the former is only $1·62, and a year's working shows a total saving of $360.

White Horses.—(Lines suggested by recent proposals.)

Chafing and rearing they start away,
Scared by the touch of a human hand,
Scattering foam in a cloud of spray;
Wild-eyed and panting, they will not stand.

They have been free since the world began,
Heedless of snaffle or curb or rein,
Galloping far from the homes of man,
Prancing and tossing each flowing mane.

Can they be broken, these dashing steeds,
Restless and strong as the wild North wind?
Will cunning Science to meet new needs
Harness the tides to assist mankind?

LESLIE M. OYLER.

London Underground Railway Speeds.—We are indebted to the *Tramway and Railway Journal* for the accompanying interesting table showing the average speeds of trains over the distances, and with the number of station stops mentioned. There has been an appreciable improvement on the routes on which "hurry-up" men have been provided. It will be noted that the average speed is in inverse proportion to the number of stops per mile. With regard to the lower speed on the City and South London Railway, the stops are exceptionally numerous, and it has to be remembered that the trains are hauled by electric locomotives instead of being equipped and driven on the multiple-unit system. On all the other lines the rate of acceleration on leaving each station is very high, and the pull up on stopping is sharp. When steam locomotives were used on the District Railway, the average train speed was 13·65 miles an hour.

—	Distance. Miles.	Station stops.	Time. Minutes.	Average speed. Miles per hour.
Mansion House to Ealing	10·9	9	27	24·2
Mansion House to Ealing	10·9	16	34	19·3
Elephant and Castle to Watford	20·8	26	62	20·13
Hammersmith to Finsbury Park	8·9	14	30	17·78
Charing Cross to Golder's Green	6·1	11	21	17·47
Charing Cross to Golder's Green (theatre)	6·1	4	16	22·84
Charing Cross to Highgate	4·4	11	17	15·55
Charing Cross to Highgate (theatre)	4·4	3	12	22·15
Liverpool Street to Wood Lane	6·8	13	24	17·0
Clapham Common to Euston	7·3	13	32	13·69

Decimal Coinage.—The Report of the Royal Commission on Decimal Coinage, of which Lord Emmott is chairman, was issued on Wednesday, last week. It emphasises the necessity of retaining the pound in any event, and states that the pound and mil system is the only one which complies with this condition; but it finds that the disadvantages of effecting the change outweigh the benefits to be gained, and decides against making any change. A minority report takes the opposite view, advocating the pound-mil system, and another minority report recommends a dollar system.

Appointments Vacant.—Charge engineer (£110 to £130 + 20 per cent. + £120), mains assistant (£110 to £130 + 20 per cent. + £120), for the Corporation of Portsmouth Electricity Supply Department; assistant engineer (£60), assistant mains engineer (£450), for the Edinburgh Corporation Electricity Works; switchboard attendant (85s. 6d.), for the Borough of Burnley Electric Lighting Department; shift engineer (£245) for the Eccles Corporation Electricity Works. See our advertisement pages to-day.

Electrically-propelled Canoe.—CORRECTION.—In connection with our article on the recent Olympia Motor-Boat Exhibition, which appeared in our issue of March 19th, wherein particulars were given of an electrically-propelled canoe, our attention has been called to the passage reading: "The motor and accumulators are concealed under the deck, the latter comprising 32 two-volt, 122-ampere Chloride 'Exide' cells in ebonite cases," and we would point out that the paragraph should have read: "The motor and accumulators are concealed under the deck, the latter consisting of 38 two-volt accumulators. The capacity of the battery at 20-ampere discharge rate, 122-ampere hours . . . ."

The Testing of Turbine Steels.—At a meeting of the North-East Coast Institution of Engineers and Shipbuilders, on March 19th, a paper entitled "Turbine Steels: a Research into their Mechanical Properties" was read by Dr. W. H. Hatfield, it being the joint work of that gentleman, of the Brown-Firth Research Laboratories, Sheffield, and of Mr. H. M. Duncan, B.Sc., of Messrs. C. A. Parsons's research laboratory, Newcastle. The research was instituted by the writers of the paper and Mr. A. D. C. Parsons, as a Sub-Committee of the British Electrical and Allied Manufacturers' Association, and was conducted with a view to determining what auxiliary tests might usefully be added to the specification in order to supplement the information obtained from existing mechanical tests. The tensile tests were carried out on a 50,000-kg. Olsen testing machine. The results generally suggested that commercial forgings were of moderately good quality steel, but that the qualities that could be induced in small masses were not obtainable, nor were they to be expected, in large masses. Turbine parts which had given satisfactory service as compared with those that had not, according to the results, suggested that design might be a factor of greater importance than the quality of the steel. As regards the indications of the various mechanical tests on the forgings and turbine parts investigated, in all cases the tensile tests gave a good indication of the quality of the material, though, perhaps, not sufficient for absolute reliance. The difference between ductility, longitudinally and transversely, was generally shown up in the figure for elongation or reduction of area, while the maximum stress reached indicated the conditions of hardness or stiffness. The Izod test, while useful for special cases where notches entered into design, was of little advantage in large turbine forgings—especially carbon steel forgings—on account of its lack of sensitiveness. The test might, however, be usefully retained in some cases of nickel-chrome steel forgings as a check on heat treatment. The authors expressed the opinion that the Stanton test probably approached nearest to the conditions likely to be met with in practice where design or accident introduced undesirable features, such as sudden changes of cross-section, sharp right-angled corners, and the effect of a blow. The experimental work also enabled the compilers of the report to recommend the Sankey test for much more attention from engineers. Unfortunately the number of tests performed was not yet sufficient to enable them to fix definitely what value should be given by the test, and to specify sufficiently definitely the conditions.

American Copper Production Costs.—Following an examination of the books of the U.S.A. copper companies, the Federal Trade Commission finds, says the *Mining Review*, that the average costs of those companies that contribute 95 per cent. of the total output were as under in 1918:—

Department.	Cents per pound.	Pounds per long ton, approximate.	Per cent. of total cost.
Mining	6·94	£32 0	42·97
Depletion of ore*	0·72	3 6	4·45
Purchase of ore	0·51	2 6	3·19
Transportation of ore	0·83	3 16	5·18
Reduction of ore	5·89	27 4	36·44
Transportation of refinery	0·85	3 18	5·28
Refining	1·02	4 14	6·36
Administration	0·89	4 0	5·56
Selling expenses	0·18	0 16	1·16
Credits for gold and silver	1·71	7 18	10·59
Labour	5·30	£24 10	32·83
Materials	3·76	17 8	23·28
Overhead	2·14	9 18	13·27
Depreciation	0·94	4 6	5·85
Depletion*	0·72	3 6	4·45
Tolls	4·99	23 0	30·91
Credits	1·71	7 18	10·59

*Depletion of ore is a charge allowed by the Treasury Department when making out taxation forms.

Unprotected Wires—Company Fined.—At Spennymoor (Durham) on March 23rd, the Weardale Steel, Coal, and Coke Co., Ltd., was fined £50 for insufficient safeguard and protection of electric wires at its by-product ovens, Tudhoe Works, whereby George Copeland met his death on February 1st, by coming in contact with a live wire. It was stated that the body of Copeland was found at the doorway of the sulphate house, his hand clutching a live wire. The opinion was expressed that deceased had picked up the wire to put it on one side, as it had blown down across the doorway. William Shand, electrical engineer for the company, said the wire was put up in the ordinary way, and added that there was no cradle underneath. The wires had been in the same condition for 12 years, and no complaint had been made until the accident occurred.

Electric Welding.—In reviewing developments in the electrical industry during 1919, Mr. J. Lister states in the *General Electric Review* that the rate of increase in the use of electric welding is indicated by the fact that in 1918 the number of welding outfits sold was more than double that of any preceding year, while 1919 in turn gave a further increase of 100 per cent. over 1918. A new D.C. welding outfit was produced which delivers current directly to the arc at the required pressure without the use of any form of ballast resistance or external regulating device. This result is obtained by means of a dual magnetic circuit, one section of which generates constant potential in part of the armature by means of a shunt field excited from this part of the armature winding, while the armature reaction and a differential series field cause a varying voltage in the other part of the armature winding. The constant potential is 30 volts, while the other component varies from plus 30 volts on open circuit to minus 30 volts on short circuit. The generator rating is 200 amperes, no exciter is required, and either A.C. or D.C. motor or belt-drive can be used. The outfit is self-contained, including a control panel, is compactly mounted so that it can be readily moved about, and weighs about 1,300 lb. A new automatic welding machine, for depositing metal varying in thickness from 25 mils to 0·25 in., was also developed for use, for instance, in increasing the diameter of a shaft by means of a self-feeding wire electrode, the shaft being rotated as in a lathe during the operation. The machine, fig. 1, consists of a pair

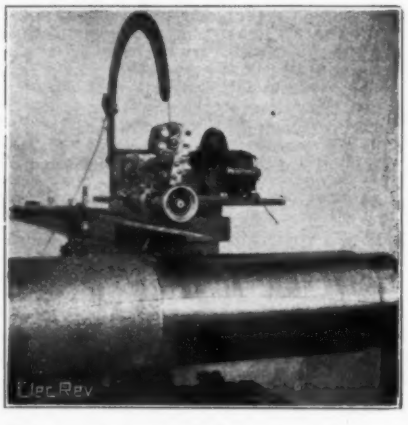


Fig. 1.—An Automatic Electric Welder.

of rolls which are driven at varying speeds by a D.C. shunt wound motor. The rolls deliver the electrode wire to the working face, and when the arc is drawn, the field and armature of the motor are instantaneously influenced by the voltage across the arc and respond by increasing or decreasing the rate of feed of the wire, thereby regulating the length of the arc to the value for which the machine is adjusted. Above the feed rolls, wire straightening rolls are provided to ensure accurate feeding of the wire and the proper location of the arc. The machine may be operated from any D.C. welding circuit, and will use any size of electrode, up to its mechanical limits, with equal precision in operation, as neither of these factors enters into the question of the rate of feed control, which is governed solely by the voltage across the arc. The complete outfit is very compact, being 4 ft. long, 18 in. wide, and 6 in. high.

Automatic Sub-Stations.—Mr. John Lister's annual summary of developments in the electrical industry in the January issue of the *General Electric Review*, is always instructive and interesting. This year he has more to tell than ever before. On the subject of automatic generating and distributing stations, Mr. Lister says that the continued popularity of the automatic sub-station is shown in the increased orders for various types and sizes up to 2,000 KW., and 1,500 volts direct current. The largest set so far constructed is a 2,000-KW. synchronous motor-generator now being installed to supplement the power supply to the Michigan Central R.R. operating electric locomotives through the Detroit river tunnel. Automatic sub station equipment was sold in Cuba, Australia, and New Zealand, and inquiries were received from other foreign countries. At the end of 1919 there were approximately 50 G.E. equipments in operation, and about 20 more being constructed or installed. The success of the automatic generating station at Cedar Rapids, Iowa, and the many railway sub-stations in service has encouraged development of others on automatic lines. An automatic hydro-electric generating station was developed for the Blue River Power Co., at Seward, Neb. This plant consists of a 240-K.V.A., 120-R.P.M., 60-cycle, 2,400-volt, water-wheel-driven generator, and three 80-K.V.A., 24,000/2,400-volt transformers, and is the first of several stations to be installed on this system. A second installation is for the Ontario Power Co., at Ontario, Cal., which consists of one 500-K.V.A., 60-cycle generator direct-connected to a Pelton water wheel. This station is not entirely automatic, but is controlled by pilot wires from a manually-operated station on the same stream. In case of necessity the station will shut down automatically. An automatic distributing station was developed for the Malden Electric Co., at Malden, Mass., and comprises a 3,000-K.V.A. transformer plant fed by a 22,000-volt line, with a second as a spare. It feeds three three-phase feeder circuits, and three single-phase feeder circuits which are controlled by automatic oil circuit-breakers with a "notching" relay. This relay will close a circuit breaker if it is tripped, and reclose it if it trips a second time within a brief period. If the short circuit has not cleared itself by this time, the circuit breaker trips a third time, and the circuit remains open until cleared and the switch closed by an operator.

The Kearney High-Speed Railway System.—*Modern Transport* is enabled to announce that the Ministry of Transport has called for a full-sized demonstration railway on the Kearney high-speed system. This decision is the outcome of a proposal made a year ago by Mr. Kearney for the linking of North and South Woolwich by means of a tube, on the Kearney system, under the river Thames. This scheme was examined in detail by the Corporations of Woolwich and East Ham, and endorsed by them, and we understand that it was also approved by the Ministry of Munitions, the War Office, the Royal Arsenal authorities, and the Great Eastern Railway Co. The test line is to be a surface railway incorporating all of the essential features of the Kearney Tube so far as gradients, curvature, and speed are concerned. A stretch of land has been retained near Brighton which fulfils all the necessary conditions. The line will commence on the western slope of Beacon Hill, and it will extend for a distance of just over half-a-mile towards Brighton. Starting on the level at Beacon Hill the line will descend by means of a gradient of 1 in 7 (as is proposed for the Woolwich Tube) until a depth of 120 ft. from the starting point is reached, corresponding with that portion of the Woolwich Tube which will be under the Thames. Then, after continuing on the level for about 500 ft., the line will ascend again by means of a gradient of 1 in 7 to a height approximately the same as at the starting point. For about 1,700 ft. from Beacon Hill the line will be run on a curve of 1 mile radius, so that it will be practically an open air duplicate of what is proposed for Woolwich. A speed of 60 miles an hour will be attained over the level section between the gradients, and the journey time from start to stop will be 1 minute. The car which is to be used in the test has already been built by the Brush Electrical Engineering Co., Ltd., of Loughborough, and will be ready shortly for delivery. It seats 44 persons, is equipped with two 35-H.P. electric motors, and has a streamline body. The four under wheels are each 3 ft., and the two guide wheels each 11 in. diameter. The weight (unloaded) is approximately 20 tons. Current at 500 volts will be generated by temporary plant at Greenway, and supplied to the car through an overhead wire suspended on the structure which supports the guide rail. The single ground rail, which takes the whole of the weight of the car, will be of the standard flat-bottom type weighing 75 lb. per yard.

Another American Turbine Failure.—Further particulars of the wreck of a large turbo-generator set in the Regina, U.S.A., power house, on January 8th, as briefly reported in our pages some weeks ago, are now to hand. The failure occurred at 7 in the morning, just after the day shift engineers had taken over the plant from the night crew. No warning of trouble was given, and that no casualties or serious damage to adjacent machinery occurred seems to have been a special dispensation of Providence. The damage is fully covered by the 12 months' guarantees of the makers.

The turbine in question, a 5,000-KW., 3,600-R.P.M., 2,300-volt, 60-cycle, 3-phase machine, was of the American General Electric Co.'s manufacture, and in this connection it is interesting to recall that three other machines by the same makers have failed in a similar manner within recent months. The accidents referred to were reported in our issues of April 12th, October 4th, and 25th, 1918.

Officials of the G.E. Co. are now inquiring into the cause of the wreck, which is said to have been due to weakness in one of the turbine wheels, a piece of which gave way and broke through the 2.5-in. casing, allowing the interior of the turbine to be scattered in all directions. When the casing gave way, the valve chamber was thrown aside, and the 9-in. diameter shaft and wheels, weighing some ten tons, was lifted from its bearings, travelled a distance of some 20 ft., and landed immediately behind the adjacent turbine set.

The wrecked turbine was only packed on its foundations in July last, being installed by the makers' representatives. It had five stages, the first with two running rows, and all the rest with one. The net weight of the turbo-generator, without condenser, was 125,000 lb., the price of the whole outfit erected being about $152,000. The makers' guarantees with 200 lb. gauge steam pressure, 2 in. absolute vacuum, and 100 deg. superheat, were: at half load 14.75; ¾ load 13.89; full load 13.68; and 1¼ load 13.89. The mean blade velocities and the mean wheel diameters were respectively as under:—

First wheel, 565 ft. per sec. and 3 ft. diam.
Second wheel, 785 ft. per sec. and 4 ft. 2 in. diam.
Third wheel, 793 ft. per sec. and 4 ft. 2.5 in. diam.
Fourth wheel, 801 ft. per sec. and 4 ft. 3 in. diam.
Fifth wheel, 816 ft. per sec. and 4 ft. 4 in. diam.

The accident places the undertaking in precisely the same by the G.E. Co. for the American Gas Co., which, however, after placing the order found that the machine would not be required, and, therefore, assigned its contract to the City of Regina. The machine was built, and others like it, but the makers found that in a similar machine weakness was suspected, the wheel of the present turbine was, therefore, dismantled and rebuilt to make assurance doubly sure (*sic.*).

The accident places the undertaking in precisely the same position as it was a year ago, the capacity of the station being only about 500 KW, in excess of the demand, which reaches 4,000 KW. between 6 p.m. and midnight in the winter months. It is hoped, however, to have certain other plant, which has been in need of repairs for some time, in commission shortly; replacements for this plant, which were on order in England, are reported to have arrived in the States.

An Electrically-propelled Yacht.—The question of a suitable type of propelling plant for a large auxiliary sailing yacht needs careful consideration. Lightness, ease of control, and a minimum space occupied are necessary, combined with the least interference with the sailing qualities of the vessel. Many methods have been employed and various types of engines have been adopted, but probably the most original system, says the *Motor Ship and Motor Boat*, is that utilised in the auxiliary yacht *Elfay*. She is the only large yacht in which Diesel electric propulsion has been adopted, and the arrangement offers considerable advantages for the vessel concerned. The *Elfay* is 152 ft. overall, with a beam of 30 ft., and a draught of 21 ft. 2 in., the length on the water-line being 115 ft., and the gross tonnage 313 tons. In 1914, 1915, and 1916, before the auxiliary power was installed, she competed in a number of long-distance races, and was one of the most elaborately equipped yachts ever built in the United States. Last autumn it was decided to fit her out and install power to give a speed of 8 or 9 miles per hour under power alone. The Winton Engine Works, in conjunction with the Westinghouse Co., carried out the installation. These two firms are now combining for providing Diesel electric equipments for large ocean-going ships, as we recently announced. The electric generating machinery consists of a 125-H.P. Diesel engine of the ordinary four-cycle Winton type, being a six-cylinder machine running at 425 R.P.M., and as it drives a dynamo it is fitted with a sensitive governor for voltage regulation. This is essential, since the load varies considerably when, for instance, it is necessary to go astern. The generator is a 75 KW. set, and there is also a 9-KW. exciter machine, which is driven by means of a noiseless chain at 900 R.P.M., and is used for the excitation of both the propelling motor and the generator. This propelling motor is placed right aft, so that there is a very short propeller shaft. It is of 90 H.P. when running at 360 R.P.M., and drives a 42-in. diameter propeller with a pitch of 42-in., this giving the vessel a speed of about 8½ knots. The speed ahead or astern is varied by altering the strength of the field in the generator. In the stop position there is no field in the generator, but a full field in the motor, whilst in the full astern position there is a maximum field in both generator and motor. The advantage of this arrangement is that the main current is not controlled, but only a small portion of the exciter current, thus rendering the handling of the vessel very simple without complicated gear. The method of controlling the speed of the vessel is as follows: The engine is started up and the cam controller switch for building up the motor field from the exciter is then put in. Next, the main contact breaker between the cam controller and the motor is switched in, these operations being carried out by the engineer in the engine-room. The whole of the rest of the control is effected from the deck by means of a deck controller on a brass stand, about 3 ft. 6 in. high. The handle has a swing of about 20 in. By moving it one-half of the circle, full speed ahead is reached, and in the opposite direction, full speed astern. In intermediate positions, intermediate variations in speed are obtained. A switchboard is fixed in the deck house, on which instruments give the voltage of the generator, motor, and exciter, as well as the current and the speed of the motor and generator, this switchboard being duplicated in the engine room. Needless to say, the electrical drive gives excellent opportunities for the convenient operation of the auxiliaries. The winch forward for handling the anchor, and, in case of necessity, for hoisting the sails, is driven by a 10 H.P. electric motor. Amidships are two additional electric winches of 4 H.P. each, for hoisting and lowering the sails. The vessel is heated throughout by electricity, and all the cabins are electrically lighted and provided with fans. The auxiliaries include a one-ton ice machine, operated by a 7½-H.P. electric motor, a water pump, a bilge pump, and an oil pump, as well as a ¾ H.P. air compressor supplying fuel to the oil range in the galley. The auxiliary air compressor is driven by a 12½ H.P. electric motor. Electric current for these auxiliaries is provided by a 25 H.P. Quaille oil engine driving a 15 KW. generator, but this is purely an auxiliary and is used to charge a set of storage batteries when the vessel is lying in dock for any length of time. These storage batteries have a rated capacity of 60 amperes for five hours, this being sufficient for all the requirements of the boat, except the actual propulsion, for two complete days without recharging. The bunker capacity is 2,400 gallons of fuel oil, giving a cruising radius of 2,000 miles, with a consumption of 7½ gallons per hour. In addition, 360 gallons of lubricating oil are carried. The *Elfay* recently started on her maiden voyage to Cuba and Bermuda.

Electrostatic Effects on Airships.—Mixtures of hydrogen and air in proportions between certain limits may be exploded by a minute electric spark. Such conditions may obtain on or near an airship, and in this connection Prof. G. S. Fulcher's recent contribution to *Aviation* on electrostatic effects on airships is of interest. As a result of the electric field near the surface of the earth, 50 to 200 volts per metre, the difference of potential between points at different heights above the surface may be very great. The charges induced on a conducting balloon depend upon the electric field in the region before the arrival of the balloon and upon charges induced on nearby conductors because of the disturbing effect of the balloon; therefore, the sudden transference of a balloon from a region of high potential to one of low, will not change the charges on the balloon, provided the strength of the field is unchanged and the balloon is not brought near a conductor. The maximum field around an originally uncharged spherical balloon is three times the strength of the field into which it is brought, if no conductors are near, and that between such a balloon and the flat surface of the ground just before contact is made is five times the original field; protuberances projecting from the balloon will have a greater field immediately around them than that stated above, increasing with sharpness and the distance they project; but except during an electric storm, and when a balloon approaches a highly charged cloud, the field around any balloon due to charges induced on it will be too weak to cause sparks.

If the speed of an airship is sufficiently great, rubberised cotton fabrics become negatively charged, while rubberised silk fabrics become positively charged. The intensity increases with the speed, approximately as the sixteenth power. The effect depends on the solid and liquid particles held in suspension in the air; dust and water particles seem about equally effective; with ordinary air the effect is small for speeds below 60 M.P.H., but in the case of smoke or mist large effects may be obtained at 40 M.P.H. The effect is associated with impact rather than with skin friction. If the fabric and ropes are conducting, the only danger is that due to the rubber rings around the valve seat, which may become charged by outflowing gas and cause a spark to pass through the gas to the valve. A precaution would be to connect the valve and the seat by a wire. The difference of potential between it and the earth as it descends may be sufficient to cause a spark. To avoid danger the landing rope should be a fairly good conductor. If the balloon chances to be in the path of a lightning flash between earth and cloud, it will probably be destroyed; but since the electric capacity of the balloon is small, a spark between it and a cloud can be prevented by relieving the electric tension by means of discharging points located as far as possible from explosive mixtures of gases. A sharp point or crown of points made of non-corroding metal, projecting above the dorsal fin of the airship and connected by wire to the steel framework of the fins, would eliminate most if not all of the danger. The following recommendations are made: It is desirable that the outer surface of the balloon envelope should be conducting so that dangerous differences of potential between the various parts may be made impossible and so that the balloon may be rapidly discharged before landing. That the inner surface of the envelope should also be conducting to prevent dangerous differences of potential from being produced by the friction of one surface upon another during inflation. That, for similar reasons, the ropes suspending the car and especially the landing rope should also be conducting, and that the latter should be so well connected to the envelope and other parts of the airship as to ensure the rapid discharge of the airship before landing.

INSTITUTION NOTES.

Institution of Electrical Engineers.—North Midland Centre.—At a joint meeting with the Yorkshire Branch of the Association of Mining Electrical Engineers on March 20th, a lecture on "Electric Winders" was given by Mr. J. Kirkwood, showing comparisons between the principal systems. The lecture was illustrated by lantern slides. Mr. W. M. Selvey welcomed the members of the A.M.E.E., and Mr. Roslyn Holliday, President of the Yorkshire Branch, responded.

Scottish Centre.—At a meeting in Edinburgh, the committee's nominations for office bearers were submitted as follows:—Chairman, Mr. J. E. Sayers; vice-chairmen, Messrs. E T. Goslin and Alex. Lindsay; hon. secretary, Mr. Joseph Taylor; assistant secretary, Mr. W. F. Mitchell (Edinburgh); chairman of Students' Section, Mr. F. A. Whysall (Greenock); members of committee, Messrs. H. Richardson (Dundee) and J. S. Nicholson (Glasgow).

Association of Mining Electrical Engineers.—At a luncheon given to prominent members of the mining industry by the North of England Branch at Newcastle, on March 20th, the speakers included Col. W. C. Blackett, Col. F. L. Simpson, Professors Henry Louis and W. M. Thornton, and Messrs. Mountain, Wilson, Ford and Severs. It was announced that the membership of the Association was now 1,275.

Edinburgh Electrical Society.—Through the kindness of Mr. John Macfee, district manager, Post Office Telephone Service, about 50 members of the Society were enabled to visit the Central Edinburgh Exchange on the evening of March 24th. The party was shown over the premises by Mr. Davies and other gentlemen connected with the engineering department. The next meeting takes place on April 7th, when short papers on everyday work will be read in competition for the Society's prize. The competition is open to all apprentices connected with the Society.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

MR. P. J. PRINGLE, general manager and chief engineer of the Electric Supply Co. of Victoria, Ltd., Australia, and his family, expect to arrive at London per the *Mantua* about the middle of April. His business address will be—The Electric Supply Co. of Victoria, Ltd., 255, Royal Liver Building, Liverpool.

Blackburn Corporation Tramways Committee has adjourned for a month the proposal to increase the salary of MR. J. H. COWELL, the general manager, from £600 to £800 per year.

Last Friday, before leaving Carlisle electricity department to take up his appointment at Walsall, MR. P. WARDLE was presentrd with a dining room clock and a fountain pen. Mr. Chas. W. Salt, the city electrical engineer made the presentation.

[Photo by] R. B. MITCHELL. [Lafayette.

MR. MITCHELL'S appointment as general manager and engineer of the Glasgow Corporation's electricity department, foreshadowed in our issue of March 19th, was confirmed on Thursday last week, and we have pleasure in presenting his portrait herewith.

MR. COUNCILLOR GRIME has been elected to the Oldham Electricity Committee in place of Councillor Makin, deceased.

As from March 31st, MR. ARNOLD B. GRIDLEY has retired from Government service, after holding the position of Director of Electric Power Supply, and Electrical Adviser to the Ministry of Munitions during and subsequent to the war. After a lengthy holiday, he hopes to resume private business.

Will.—The late MR. C. E. GROVES, F.R.S., left £33,022 gross and £32,857 net personalty. On the death of certain legatees, £10,000 is to go to the Royal Institution for the Groves Endowment Fund for the promotion of scientific research.

NEW COMPANIES REGISTERED.

Gwynnes Engineering Co., Ltd. (165,547).—Registered March 22nd. Capital, £600,000 in £1 shares. There is also to be £300,000 7½ per cent. debenture stock, redeemable at 105 per cent. in December, 1939. £200,000 shares are to be offered to the public at par and all the debenture stock is to be offered at 95 per cent. Objects: To acquire (a) the business, stock and work in progress of Gwynnes, Ltd., (b) certain freehold, leasehold and copyhold property at Criap Road, Hammersmith, and Church Wharf, Chiswick; (c) all the issued share capital of Adam Grimaldi & Co., of Albert Works, Vauxhall, S.W., who have been associated with Gwynnes, Ltd., in the development of the Albert car. The purchase price payable to Gwynnes, Ltd., is limited to £575,000 (£225,000 in cash and £350,000 in shares), nothing being payable for goodwill. General powers are taken to carry on business as manufacturers of pumps, pumping machinery, internal combustion, salvage, agricultural, electrical, marine, aero and general engineers, boiler makers, &c. The first directors are: Sir Byron Peters, K.B.E., M.I.Mech.E., Windlesham Moor, Windlesham; Jas. M. Dewar, M.I.N.A., M.I.Mech.E., Allington, Northwood, Middlesex; Nevile C. Gwynne, M.I.N.A., M.I.Mech.E., Vevendean, Oxshott, Surrey (managing director); J. G. Mair-Rumley, M.Inst.C.E., M.I.Mech.E., Hammonds, Udimore, Sussex; W. W. Wilkes, 16, Thurlestone Road, West Norwood, S.E.27, secretary. The trustees for the debenture stock holders may, so long as £175,000 of the debenture stock is outstanding, nominate one director. Qualification (except debenture stock director), £1,000. Remuneration, £500 each per annum (chairman £750). Solicitor: W. Harrison, 25, Bloomsbury Square, W.C. Registered office: Hammersmith Iron Works, Crisp Road, Hammersmith.

Associated Industries Insurance Corporation, Ltd. (165,439).—Registered March 19th. Capital, £1,000,000 in £1 shares (900,000 7 per cent. participating preference). To carry on marine, land transit, fire, life, accident, burglary, boiler, engine, electrical plant, motor, aerial and general insurance business, &c. £20,000 Exchequer Bonds have been deposited with the Court in respect of bond investment business and £20,400 in respect of life assurance. The subscribers (who are also provisional directors) are: A. Long, 51, Harvist Road, N.W.6, secretary; T. Walford, Lilleshall Villa, Mawneys Road, Romford, accountant; A. Brigstock, 1, Tanored Road, Finsbury Park, N.4, book-keeper; C. M. Jenner, 29, Larnier Road, S.E.13, clerk; W. Gull, 8, Wragby Road, E.11, secretary; T. W. Simpson, 3, Carlyle Road, E.12, clerk; R. P. Care, 46, Birkhall Road, Catford, S.E., clerk. Four-fifths of the directors to be subsequently appointed are to be shareholders holding policies effected with or through the company (to be known as "policy holder" directors) and one-fifth are to be shareholders not holding such policies (to be known as "shareholders'" directors). Qualification, £500. Remuneration, £300 each per annum (president £300 extra), all free of income tax, and any further sums voted by the company. Solicitors: Kerly, Sons and Karuth, 10-11, Austin Friars, E.C.

R. P. Boyd & Co., Ltd. (165,423).—Private company. Registered March 18th. Capital, £10,000 in £1 shares. To carry on the business of manufacturing, electrical and mechanical engineers, manufacturers and workers of metals, minerals, wood, porcelain, glass, asbestos, india-rubber and natural and synthetic products, &c. The first directors are: J. M. Newton, 19, Burton Street, Loughborough, manager with Brush Electric Co., Ltd.; R. P. Boyd, 115, Barclay Road, Warley Wood, Smethwick, Birmingham; G. H. Sherrow, Churchfield, Harborne, Birmingham. Solicitor: D. Blackadder, 32, Castle Street, Dundee. Registered office: Hooper Street, Birmingham.

Vickers-Helvetia.—Private company. Registered March 20th. Capital, £1,000 (£1). To carry on the business of manufacturers of and dealers in steel, iron, brass and metals, founders, metal workers, shipbuilders and shipwrights, manufacturers of guns, torpedoes and ordnance of all kinds, electricians, electrical engineers, &c. The first directors are: Sir Francis H. Barker, Lowndes House, Lowndes Place, Belgrave Square, S.W.; S. V. Dardier, The Grange, 48, Grange Road, Ealing, W.5; N. Robinson, Westmoor Green House, near Slough. Solicitor: F. H. E. Branson, 2, Bond Court, Walbrook, E.C. Registered office: Vickers House, Broadway, Westminster. (165,529.)

Paterson Manufacturing Co., Ltd. (165,557).—Private company. Registered March 22nd. Capital, £10,000 in £1 shares (4,000 preference). To carry on the business of electrical and mechanical engineers and contractors, electricians, &c. The first directors are: T. Erndt, 56, Warren Road, Leyton, E.; H. E. E. Ault, 75, Malvern Road, Thornton Heath, Surrey; L. G. Clarke, Ridge Vicarage, Barnet, Herts. Secretary: H. E. E. Ault. Solicitor: T. L. Grimes, 3, Finsbury Circus, E.C.

Dick, Kerr & Co., Ltd. (165,546).—Private company. Registered March 22nd. Capital, £100 in £1 shares. To carry on the business of electrical and general engineers and contractors, &c. The subscribers (each with one share) are: E. J. Alldis, 18, Macdonald Road, E.7, clerk; G. Dickson, 4, London Road, S. Benfleet, clerk. Table "A" mainly applies. Registered office: Queen's House, Kingsway, W.C.

Precision Instrument Co., Ltd. (165,516).—Private company. Registered March 20th. Capital, £5,000 in £1 shares. To carry on the business indicated by the title. The first directors are: E. W. Smith, Eastwood, Worcester Park; E. A. Petithory, 36, Dartmouth Road, Forest Hill, S.E.; F. C. Harding, Bracekenwood, Leatherhead. Secretary: R. E. Petithory. Registered office: 25 and 27, London Road, Forest Hill, S.E.

A. Murray & Co., Ltd. (165,486).—Private company. Registered March 20th. Capital, £4,000 in £1 shares. To take over the business of electrical, mechanical and motor engineers carried on by A. Murray, H. Morris and D. Murray at Liverpool. The first directors are: A. Murray (chairman), 4, Viola Street, Bootle; H. Morris, 6, Victoria Road, Litherland, Liverpool; D. Murray, 5, King Street, Newcastle-on-Tyne; R. J. Hamilton, Laurel Bank, Buxton Road, Stockport; R. W. Anderson, 54, Derby Road, Liverpool; J. Connell, 22, Queen's Road, Bootle. Solicitor: G. Oates, 20, Cross Street, Manchester. Registered office: 15, Brazennose Road, Liverpool.

Will Smith, Ltd. (165,533).—Private company. Registered March 20th. Capital, £2,000 in £1 shares. To take over the undertaking of W. Smith, electrical manufacturer's agent, general electrician and contractor, of 24, Hampstead Road, Liverpool. The first directors are: W. C. Smith, 24, Hampstead Road, Liverpool; T. Richards, 73, Hampstead Road, Liverpool. Registered office: 21 and 23, North John Street, Liverpool.

Woodward Sons & Co., Ltd. (11,051).—Private company. Registered March 18th. Capital, £5,000 in £1 shares. To take over the business carried on by F. J. Woodward, electrical engineer and contractor. The subscribers (each with one share) are: F. J. Woodward, Overton House, Riddrie, Glasgow, electrical engineer; J. O. Woodward, Overton House, Riddrie, Glasgow, electrical engineer; F. Woodward, Overton House, Riddrie, Glasgow, electrical engineer. The first directors are: F. J. Woodward, J. O. Woodward and F. Woodward. Secretary: J. O. Woodward. Registered office: 147, Renfield Street, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Musselburgh and District Electric Light and Traction Co., Ltd.—Bond and disposition in security, dated March 10th, 1920, to secure £400, 15, Ravenshaugh Road, or/and 1, Mayville Bank, Musselburgh. Holder: D. A. Tod, Braehead, Dunkeld.

Switchgear & Cowans, Ltd.—Issue on March 11th, 1920, of £11,500 debentures, part of a series already registered.

Connollys (Blackley), Ltd.—First debenture dated March 9th, 1920, to secure £10,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: London County Westminster and Parr's Bank, Ltd., 41, Lothbury, E.C.

Quain Electric Co., Ltd.—C. W. Rooke, of 2 and 3, Norfolk Street, Strand, W.C., as receiver and manager by Order of Court dated March 12th, 1920.

CITY NOTES.

City of London Electric Lighting Co., Ltd.

Mr. J. B. Braithwaite, presiding at the annual meeting on March 24th, said that the year 1919 was the most difficult year the company had been through. He referred to strike troubles, the time absorbed by the Electricity Bill, and to coal supply difficulties. Under the circumstances they could congratulate shareholders upon a relatively good statement. The gross revenue increased by

£134,707, but that increase had been very largely absorbed by increased costs. The result was that they carried £179,991 to net revenue account, an increase of £41,835. That they had any balance at all was almost entirely due to the great activity which had prevailed in the City and the great increase in their business in the latter months of 1919. They had sold 4,599,698 additional units. Had it not been for that increase in the units sold, which had produced something like £73,000, the company would have come out without any increase in profit at all. As it was, the great increase in business during the last few months of the year had enabled the company, in addition, to make a reduction to their customers on the extra charges that had been put on for war expenses. With the uncertainty of the outlook at present, they could not make a further reduction in the price at the moment. They were raising the dividend from 8 per cent. to 10 per cent.—the pre-war figure—and in addition were restoring two years of the war-rate to the 10 per cent. basis, which would take the form of a bonus of 3 per cent., and would still leave two years to be made good on a future occasion if profits admitted of that. With regard to the depreciation fund, he would like to point out, in view of the capital proposals which were to be laid before the shareholders, exactly what had been done out of revenue during the last 19 years. The total amount provided from revenue and other sources from 1901 to 1918 was no less than £1,161,314. In other words, they had carried on the affairs of the company for 19 years without making any further capital issue. Referring to the Electricity (Supply) Act, the speaker said that in the Act as it stood the Electricity Commissioners would have power to approve schemes brought forward by authorised undertakers for giving a supply of electricity on a comprehensive scale. Their own company, owing to its central position and the abundant supply of condensing water it possessed, was in a position to aid very materially in the provision of a comprehensive supply for the London area, and the directors had already placed orders for large generating units, which would enable them to provide for the growth of the company's own business, and to give bulk supply to the neighbouring undertakers pending the completion of the super-power house down the river, which it was anticipated would form a feature of any comprehensive scheme put forward. The board had already entered into an agreement with the County of London Electric Supply Co. for the supply of a considerable amount of current in bulk, and it was hoped to have that supply available by the end of the year. It was obvious that capital expended on works of this character undertaken in the interests of the general supply of electricity to the London area must receive special protection, and in his opinion the only chance of cheapening the supply of electricity in the London area was by utilising and co-ordinating the resources of the existing companies. Their engineer estimated that it would be possible to put down additional plant at Bankside to increase the capacity up to 100,000 KW.; that figure included the present plant and the three large units now on order, and would still leave a margin for a substantial contribution to tide over the interregnum until the new power house down the river was ready to deliver current. Accordingly, if proper security was given for the capital outlay, their company would be able to save the whole of London from running short of an electricity supply during the next three or four years. As to the outlook for the present year, their own business continued to show extraordinary expansion, and the demand showed no signs of slackening at present. With the additional revenue derived from the bulk supply he looked forward with confidence to the results of the present year's working, in spite of the difficult conditions still obtaining. To carry out the extensive programme outlined above would involve the expenditure of a considerable amount of capital, and resolutions for increasing the capital by £800,000 would be proposed at the extraordinary meeting to be held on April 14th.

British Insulated and Helsby Cables, Ltd.

Presiding at the annual meeting at Liverpool on March 22nd, Sir J. S. Harmood Banner said that the profit for the year showed an increase of £40,408. With the exception of 1917 the profit was the highest they had ever earned. During the year war work ended and a complete change over to their ordinary business in wires and cables took place. So great had been the demand for these that they had been subjected throughout the year to a constant pressure to deliver more than they could manufacture, and that pressure still continued. This remark also applied to the accessory products, which now formed a very important part of the business. The bonus of 2½ per cent. (in addition to the 12½ per cent. dividend) must not be taken as a precedent. After alluding to the business of the Midland Electric Corporation for Power Distribution, in which they were largely interested, also the Electric Supply Co. of Victoria, and the Automatic Telephone Co., the speaker referred to a statement which had appeared in the Press to the effect that the Government were going to spend a large sum of money on the telephones of the country, and that they were to have a splendid system in existence. He said it was just as well for those who used the telephone to remember that it was going to be the old-fashioned system, and not the automatic system adopted in America almost entirely, and elsewhere, and, in his opinion, the Government would very shortly have to pull out what they were spending and come back to them for automatics. The changes which had been made during the war and the immediate duty to ensure the largest possible output of commodities made it necessary to rearrange the works and to add important buildings and machinery, and the very satisfactory result of the year's working was largely due to the devotion of the staff under new and trying conditions.

At an extraordinary meeting which followed it was resolved to increase the capital from £1,500,000 to £2,000,000 by the creation of 500,000 new shares of £1 each as the directors might determine. The chairman said that in the future they might have to find enormous funds for stores, there might be big rises in price of material, wages were up, and they did not want to be caught so that when they found a favourable opportunity for the issue of capital they would not have the means at their disposal. There was not the slightest intention of an immediate issue, but they wanted to be ready when the time came.

Midland Electric Corporation for Power Distribution, Ltd.

Sir J. S. Harmood Banner, M.P., presiding at the annual meeting, said that the net revenue amounted to £89,438, an increase of £28,171. The capital expenditure for the year, amounting to £32,814, was chiefly for mains, transformers, &c., for new connections. The increase of £64,018 in gross receipts was very satisfactory, but it was quite impossible to say what the cost of generation and distribution would be in the future owing to the continual awards in respect of coal prices and wages. If the new demand by the Miners' Federation for higher wages, which was estimated to work out at 3s. per ton, should be acceded to, the extra charges to the company would be about £15,000 per annum. An increase in wages of 5s. per week per employé, plus Mr. Churchill's 12½ per cent., was made in December last, while a further increase of 6s. per week, plus the 12½ per cent., had been agreed upon in the engineering trade. In addition, the undertaking had been recently reassessed at a much higher figure for local rating purposes. These heavy charges made one almost despair of the future. With those extra charges it was impossible for the board not to make further advances in charges for energy. The increased profits for the year were largely due to the expansion of the business and to economies effected.

At a subsequent extraordinary general meeting it was resolved that in order to provide for additional expenditure the ordinary share capital be increased by £200,000, and that the £5 ordinary and preference shares be divided into £1 shares.

London Electric Wire Co. & Smiths, Ltd.

Sir G. H. Fisher Smith, M.P., presided at the annual meeting on March 23rd. He said that during 1919 they had had the greatest output since the business was inaugurated. The demand for their products continued to increase greatly. After being occupied in producing certain goods required by the Government, they had now resumed their usual business to a large extent. At present they had orders on hand which would last them many months to come. The demand was likely to continue for some considerable time, and they were endeavouring to make arrangements to cope with it. Consequently last year they issued £350,000 preference shares, and the issue was subscribed many times over. They had spent £93,749 for extensions in the form of new buildings and new machinery, necessitated to a great extent by the increased demand for the company's products, and also by the cessation of all night work. During the year they had had considerable difficulties to contend against. Shorter working hours naturally meant less production, but nevertheless the results were very satisfactory. At the present moment the country was passing through a most difficult time, but he had every belief in the sanity of the English nation, and although there were a good many clouds hanging over the commercial world, he thought these clouds would in time disappear. There never was in the history of this country a greater demand for English goods than there was at the present time, and the production was not anywhere equal to the demand, but in course of time further machinery would be put down in order to increase production.

Constantinople Telephone Co.

At a meeting of the holders of the obligations, held in London, on March 24th, the resolution approving the scheme for discharging the arrears of interest since July, 1914, by the issue of certificates bearing interest at 6 per cent. per annum, was passed. Sir Alexander Roger, who presided, said that the company's operations were suspended by the Turkish Government taking over its plant on March 15th, 1915, and the company did not regain possession until April 1st last. They had made a claim against the Turkish Government, but it was impossible to say what the result would be or what period would elapse before any settlement was come to. Under the circumstances the directors came to the conclusion that some arrangement should be come to as early as possible for the purpose of discharging these arrears of interest. It was also proposed to deal with the pre-war indebtedness to contractors and others in the same manner, that is, adding 6 per cent. per annum to the ascertained amount of their accounts and issuing certificates for the

aggregate amount of principal and interest. The political situation in Turkey was unsettled, but they hoped that when peace was signed matters would settle down and the trade of that country improve under the new conditions which must prevail. When they obtained repossession of the property a modification of the concession under which they worked the telephone system was granted for the time being by the Turkish Government in view of the altered circumstances and the increased cost of working. As a result the earning power of the company was improved, and they had every reason to believe that, unless anything unforeseen happened, they would be in a position to pay the interest on the obligations and the certificates which it was now proposed to issue.

Newcastle-on-Tyne Electric Supply Co., Ltd.

The annual meeting was held in Newcastle on March 25th, Mr. J. H. Armstrong presiding. The Chairman said that a year ago, being in doubt as to what the future might bring, they recommended that £41,427 should be carried forward; they wished to maintain the ordinary dividend for 1919 at the same rate as the two preceding years, and accordingly they again recommended the payment of 8 per cent. on the ordinary shares and to transfer £50,000 to the reserve. On this occasion they proposed to make no addition to the reserve for special depreciation and contingencies. They had good reason for knowing that the value of their assets duly represented the amount at which they stood in the books without bringing into account the unappropriated balance standing to the credit of the reserve fund. During the whole of the nine months after their meeting the whole of the trade of the district was adversely affected first by the railway strike and later by the moulders' strike. The latter dispute started in September, 1919, and did not terminate till the end of January of the present year. When it was borne in mind how seriously their business was affected by those stoppages, and by the disorganisation due to the change from war to peace work, it was not difficult to account for the falling off in their profits. Speaking as to the prospects of the company, the Chairman said they had now in commission some of their newer and more economical plant, and they looked forward before long to having further sections of this plant available for service. They were thus in a favourable position to deal with any load they were likely to be called upon to meet. The charts of their output showed a steady improvement as compared with last year. The effect of the moulders' strike was still felt by manufacturers, but when that had entirely disappeared the rate of improvement should materially increase. The applications on hand represented 82,900 H.P., which showed a substantial increase over the position twelve months ago. Provided that nothing occurred to interfere with the efforts that were being made by all large customers to increase production, he was satisfied they would be able to meet next year under happier circumstances. In view of the possible strike of miners, it was necessary for him to say that its effect, if of long duration, would be as serious as it would be disappointing in upsetting the prospects of a return to normal conditions.

Mr. R. P. Sloan, the manager, referred to the Electricity (Supply) Act. He said that through the deletion of the compulsory purchases clauses, the worst features of the Bill had disappeared. Although the Newcastle Company was the pioneer public electricity supply undertaking in the kingdom to introduce the three-phase A.C. supply, adopting a periodicity of 40 cycles per second as its standard, many independent undertakings on the North-East Coast, which came into existence later, adopted different systems and periodicities. The extension of the Newcastle system and the linking up to it of one undertaking after another had necessitated the expenditure of many thousands of pounds in changing over from the existing system to the system of the Newcastle Co. As an illustration of this he referred to the Cleveland Co.'s undertakings, where no fewer than three distinct systems of supply were in existence—none of which were the same as that of the Newcastle Co. Had the Board of Electricity Commissioners been in existence in the past, the multiplicity of generating stations and the extraordinary difference in the systems of generation which now existed throughout the country would not have been permitted, as one of the main duties of the Commissioners would have been to insist on concentration of generation and the adoption of standard systems of supply. Speaking of matters more directly affecting the company, he alluded to the substantial increase in the wages bill, which for the last year totalled £206,124, or an increase upon the basic rates of 92 per cent. The general feeling of uncertainty which had prevailed throughout the country was reflected in the comparatively small connections made to their company during the past year—7,686 H.P. The revenue they had received from these increased connections had only to a small extent counteracted the effect of the considerable reduction in their load due to the cessation of munitions manufacture. Turning to the brighter side of the picture, he was pleased to say that the tests that they had carried out on the sections of new generating plant so far completed had proved that the economies forecasted by the chairman at the meeting in November would be eventually fully realised as the plant was brought into commercial operation. The delay in the completion of the plant was a result of the strike, and the dates for the completion of the work at Carville power station, the extensions at Dunston, and the new Tees station had had to be extended from two to three months in each case, and the effect of the delay was that they would not obtain the full benefits that they had hoped for from the new plant as a result of the saving in coal consumption. The delay in finishing the Tees station was particularly regrettable, as the Cleveland area had for some considerable time been handicapped through a shortage of generating plant, and it had been necessary in order to meet the demands made upon that company to depend largely upon supplies obtained from generating plant that was far from economical. He concluded with a brief reference to the proposed electrification of the North-Eastern Railway main line between Newcastle and York. The development, if it took place, would be one of the most important in the railway world for many years. Negotiations were proceeding at the present time between the railway company and that company.

London United Tramways, Ltd.—The report states that the operation of the undertaking during 1919 resulted in gross receipts of £496,542, an increase of £134,115 over 1918. Owing to continued advances in cost of labour and material, the working expenses increased by £122,855 to £496,687. There is an adverse balance on working of £145. After charging debenture and loan interest for the year and bringing into the account the debenture interest for 1918 paid in May, 1919, the total deficiency to be carried forward to 1920 is £71,577. The expectations in regard to the increase of revenue to be derived from the raising of fares have been fully realised, but owing to the introduction of the eight-hours day, various labour awards, and the general rise in the cost of material, the additional revenue has been more than swallowed up by increased expenses. In the balance sheet effect has been given to the scheme of reduction and rearrangement of the capital. The company's Bill to authorise an increase in fares, &c., has passed second reading in the House of Commons.

Clyde Valley Electrical Power Co.—The balance of profit for 1919, including the amount transferred to contingency fund as stated below, is £135,751, plus £23,335 brought forward. The preference dividend absorbs £18,000; there is written off cost of accounts and duty on increased capital £2,784; transferred to contingency fund for depreciation £50,000; dividend on the ordinary shares, 5 per cent. for the year, £30,000; carried forward £58,302. The 15,000-KW. turbo-alternator at Yoker power station is now in operation. The extensions at Clyde's Mill power station for the installation of a 15,000-KW. turbo-alternator are proceeding; the plant will be in operation for next winter's load. The directors express regret at the loss of the services of Mr. Arch. Page, the general manager, on his appointment as an Electricity Commissioner. Mr. E. T. Goslin has been appointed in his stead.

Rangoon Electric Tramway & Supply Co., Ltd.—At the meeting held in London on March 25th, Sir F. W. R. Fryer, who presided, referred to the favourable position of the company, and said that this was the last occasion on which he would preside at the annual meeting as control was to be removed to Rangoon. The directors were convinced that the course adopted was based on sound reasons, and that the alteration was calculated to promote the future advancement and prosperity of the undertaking. On and after April 1st next the company would be represented in London by Messrs. R. Lawrence Spicer & Co., as London agents.

Dividend on the ordinary shares 7 per cent. for 1919, free of tax. Carried forward, £1,360. Total receipts increased by 12.58 per cent. Private lighting and power gross receipts increased by 11.87 per cent.

Browett, Lindley & Co., Ltd.—Net profit for 1919, £20,891, plus £10,593 brought forward. A further dividend on the preference shares of 9 per cent. on account of arrears and a dividend of 8 per cent. and a bonus of 4 per cent. on the ordinary are to be paid, leaving £19,484 to be carried forward. The *Financial Times* says that the question of further capital for enlarging the works on the lines of bulk production of standard engines is to be considered at once.

Mirrlees Watson Co., Ltd.—Dividend of 10 per cent. and a bonus of 7½ per cent., both less tax. £20,000 to reserve and £11,299 carried forward. The capital is to be increased to £250,000 by the creation of 125,000 additional £1 shares, 50,000 of which are to be issued to shareholders in the proportion of two for every five now held. 25,000 shares are to be made available on special conditions for employés and others directly interested in the business.

Stock Exchange Notices.—The Committee has specially allowed dealings in the following under Temporary Regulation 4 (3):—

Mann, Egerton & Co., Ltd.—Option certificates to bearer in respect of 19,023 ordinary shares.

Metropolitan-Vickers Electrical Co., Ltd.—20,172 ordinary shares of £1 each, fully paid, Nos. 6,185,001 to 6,205,172.

Liverpool District Lighting Co., Ltd.—Mr. C. McLaren presiding at the annual meeting on March 23rd, said that the sale of energy increased very considerably during 1919, and it was still increasing. Many more consumers might have been connected had they been able to get the necessary cable and meters. A new main cable was to be laid to Seaforth to deal with the growing demand there. They would not

install any new generating plant at the Waterloo power station this summer, but it might be necessary to do so next year. Profit had increased from £2,469 in 1918 to £5,841 in 1919, due to increased consumption and increased price.

Newmarket Electric Light Co., Ltd.—During 1919 the new lamp connections were 1,882 (33 watts), making the total 35,692. Profit £2,351, as against £2,156. Debenture interest £710. Balance brought forward £412. Owing to the rising cost of machinery and plant a larger amount is put to plant renewals (£1,750); £303 is carried forward.

Electro-Bleach & By-Products, Ltd.—Further dividends are announced, making a total of 7 per cent. for the year (less tax) on the preference shares, and of 14 per cent. on the ordinary.

Sunderland District Electric Tramways, Ltd.—Year ended October, 1919. Dividend 5 per cent., less tax, upon preference shares. Carried forward £1,208.

South Metropolitan Electric Tramways & Lighting Co., Ltd.—Profit for 1919, £22,264; £7,500 for renewals; £5,000 to reserve; 6 per cent. preference dividend; £1,507 carried forward.

British Ever-Ready Co., Ltd.—Dividend 15 per cent. on the ordinary shares.

STOCKS AND SHARES.

SATURDAY EVENING.

"OWING to the Easter holidays, please note that your article will be required two days earlier than usual." And so it befalls that yields p.c. may get entangled with the results of the 'Varsity sports, while, if the word Boat Race should happen to appear in obvious error for the Stock Exchange, may a kindly indulgence be extended to the hapless host of a boys-and-girls party to view the contest.

The principal effects of the Stock Exchange slump may now be regarded as past, and the markets show a moderate movement towards recovery. With the turn of the first quarter of the year, money will naturally become a little easier, so Bank Rate fears are relegated to the background. Nevertheless, the demands for accommodation on account of trade are so pressing and so widely spread that certain banks have rationed their customers as to loans. This is a state of affairs practically unique, and its influence is felt in hundreds of directions amongst trade and financial circles.

It is difficult to suppose, for instance, that the money famine has no part in governing the remarkably low range of prices now ruling in the electricity supply list. Brompton & Kensington ordinary yield no less than 9¼ per cent. on the money. Charing Cross pay a shilling or so more than this. County ordinary offer 8½ per cent. Westminsters, St. James' and Pall Mall and London Electric preference give an average of 8¾ per cent. on the money. Such returns are in themselves good enough, but they are wedded to prospects of better things in the future, such as were ably set forth in the chairman's speech at the recent County meeting. Bromptons look as cheap as anything in the list at 6½ ex the dividend.

Of course it is not to be overlooked that the standard of yields from investments has been greatly modified by the outpouring of new issues during the past three months. The attractions offered by the newcomers have had perforce to be made more and more tempting, with the consequence that stockbrokers find their clients want 8 to 10 per cent. yields from ordinary shares, and 7½ per cent. from good-class preferences.

Amongst Home Railway stocks, a jump of 5 points in Underground Electric income bonds accompanied the progress of the company's Bill seeking powers to charge increased fares. Another factor contributing to the spring in the price was the announcement that there will be no strike on the tubes over the Easter holiday. The £10 shares rose 7s. 6d., and Districts put on a point. If permission to raise fares should enable the company to resume 6 per cent. interest on the income bonds, the latter at 75 look cheap, because the dividends are distributed free of tax, and coupons are payable, moreover, in New York as well as in London.

Another fortnight remains in which holders of the cable stocks and shares can make up their minds whether to apply for their rights or to sell them. The new Eastern shares touched 8s. before reacting to 6s. 9d. Eastern Extension new are 3¼ premium; Globes and Westerns both about 3⅛ premium. Movements in the prices of the old stocks are unimportant. Westerns at 15 ex dividend show tax-free return of 6 2-3 per cent., and Globes pay similarly. Eastern ordinary is about 3 down on the week. Oriental Telephones have lost a little of their sudden and mysterious strength. Marconis at 3 7-16 show ¼ loss, there being a good deal of selling on behalf, apparently, of tired speculators weary of waiting for a rise that does not come. Great Northerns at 22½ shed 30s. in company with other Danish issues affected by foreign exchange. Telegraph Constructions are 25½ ex dividend.

London United Tramways preference were sold at half-a-crown on the issue of the report showing the company to have made £200 loss on the last year's operations. From whatever political angle the position may be reviewed, it seems ludicrous that any such undertaking which performs service of undoubted public utility should be run at a loss to those who put up the money, and whose original capital was ruthlessly scaled down in a reorganisation scheme. The 4 per cent. debenture stock stands about 38½. London and Suburban ordinary are 2s. 3d., the preference 4s. 3d., and the two debenture stocks 42½ and 70 for 4½ per cent. and 5 per cent. respectively.

Manufacturing shares are heavy. Edisons at 1½ are 2s. 6d. lower. Metropolitan-Vickers preference have gone back to 2½, although the report was favourably read. The ordinary are 27s. 6d. Siemens at 28s. 6d. are sixpence down. Babcock & Wilcox at 3 3-16 continue their decline. British Insulated are quoted 38s. 9d. ex dividend and bonus, while Aluminiums braced up to within a shade of 40s. General Electrics are quiet, and there is not much doing altogether in this section.

Mexican issues keep on falling; this week it is Mexican Light and Power firsts which are down, a loss of 4 reducing the price to 47½. British Columbia Electric Railway stocks look as though they may have gravelled after their long drop. Bombay Electric ordinary are not quite so good at 145; the preference at 18¾ have shed 5s. Brazilian Tractions weakened with the country's bonds. Argentine Tramways hold their ground. Rubber shares are dull and uninteresting. The commodity fell to 2s. 3d. per lb., but rallied a trifle, and the bulls in the share market resigned themselves to the prospect of there being no likelihood of recovery until after Easter.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price March 26, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	6½xd	—	£9 4 8
Charing Cross Ordinary	4	7	8½xd	—	9 6 8
do. do. do 4½ Pref.	4½	4½	2⅝	—	8 8 8
Chelsea	3	4	8xd	—	6 3 4
City of London	8	10	13½xd	— ⅛	7 11 0
do. do. 6 per cent. Pref.	6	6	9½xd	—	6 9 8
County of London	7	8	9⅝xd	—	8 10 8
do do. 6 per cent. Pref.	6	6	9xd	—	6 13 4
Kensington Ordinary	6	7	5xd	—	7 0 0
London Electric	Nil	2½	1⅜	—	5 2 6
do. do. 6 per cent. Pref.	6	6	8⅜	—	8 17 10
Metropolitan	5	6	3⅜xd	—	8 0 0
do. 4½ per cent. Pref.	4½	4½	2⅛	—	8 0 0
St. James' and Pall Mall	10	12	6⅜	—	8 16 10
South London	6	6	2⅝xd	+ ⅛	7 12 8
South Metropolitan Pref.	7	7	19/6	—	7 3 7
Westminster Ordinary	8	10	5⅜	—	8 13 10
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	8½	— 1	6 18 9
do. Def.	33/6	1½	19	—	7 18 0
Chile Telephone	8	6	6½	—	*1 13 2
Cuba Sub. Ord.	7	7	10	— ½	*7 0 0
Eastern Extension	8	10	15½	— ¼	*6 10 1
Eastern Tel. Ord.	8	10	154½	- 3	*6 9 5
Globe Tel. and T. Ord.	8	10	15	— ⅜	*6 18 4
do. do. Pref.	6	6	9½	—	6 6 4
Great Northern Tel.	22	—	22½	— 1½	9 15 6
Indo-European	13	—	48⅝	—	6 13 4
Marconi	25	—	3 7/16	— ¼	7 5 4
Oriental Telephone Ord.	10	—	7⅜	— ¼	3 16 1
United R. Plate Tel.	8	—	7⅞	—	*5 3 3
West India and Panama	1/3	—	1 1/16	—	5 19 0
Western Telegraph	8	10	15xd	—	*6 13 4
HOME RAILS.					
Central London Ord. Assented	4	4	47½	—	8 8 6
Metropolitan	1	1½	21½	—	5 16 3
do. District	Nil	Nil	18½	+1	Nil
Underground Electric Ordinary	Nil	Nil	2⅜	+ ⅜	Nil
do. do. "A"	Nil	Nil	6/6	—	Nil
do. do. Income	5	4	74	+5	5 6 8
FOREIGN TRAMS.					
Anglo-Arg. Trams. First Pref.	Nil	Nil	8⅜	—	—
do. do. 2nd Pref.	—	—	8¼	—	—
do. do. 5 Deb.	5	5	62*	—	7 15 0
Brazil Tractions	—	—	51½	—1	—
Bombay Electric Pref.	6	6	18⅝	— ½	3 3 0
British Columbia Elec. Ry. Pfce.	5	5	59½	—1	8 5 4
do. do. Preferrred	2½	5	50½	—1	9 18 0
do. do. Deferred	Nil	3	42½	+1	7 1 2
do. do. Deb.	4½	4½	57	—	7 9 1
Mexico Trams 5 per cent. Bonds	Nil	Nil	38½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	24½	- 8½	Nil
Mexican Light Common	Nil	Nil	17½	—	Nil
do. Pref.	Nil	Nil	27½	—	Nil
do. 1st Bonds	Nil	Nil	47½	—4	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	—	3 3/16	— ¼	*4 14 2
British Aluminium Ord.	10	10	1 15/16	+ 1/16	5 5 0
British Insulated Ord.	12½	15	1 5/16xd	—	7 14 8
Callenders	25	—	8⅝	—	7 2 10
,, 6½ Pref.	6½	6½	4⅝	—	6 16 10
Castner Kellner	20	—	4	—	—
Crompton Ord.	10	—	21/6	—	9 6 0
Edison-Swan, "A"	10	—	1⅜	— ⅛	8 17 10
do. do. 5 per cent. Deb.	5	5	79½	—	6 5 9
Electric Construction	10	—	23/-	- 6d.	8 13 10
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 6
do. Ord.	10	—	1 1/16	—	*5 10 4
Henley	25	15	2⅜	—	6 6 4
do. 4½ Pref.	4½	4½	3⅜	—	6 4 2*
India-Rubber	10	—	16	—	*6 5 0
Met.-Vickers Pref.	—	8	2⅜	— ½	6 2 0
Siemens Ord.	10	10	2 7/16	— 6d.	*7 0 4
Telegraph Con.	20	20	25½xd	—	*4 14 1

* Dividends paid free of Income Tax.

WIRELESS TELEPHONY ON AEROPLANES.

By MAJOR C. E. PRINCE, O.B.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, Wireless Section.)

The summer of 1915 is believed to have been the very first occasion when wireless speech was received from an aeroplane. At that period the soft valve was in use, with a lime-coated platinum filament, and the handling of this by unskilled persons was one of the greatest difficulties. Except for this, the purely electrical difficulties have throughout been far less serious than the telephonic, practical, and mechanical ones.

In the early stages the difficulties of reception of speech in the air were so great that only transmission from air to ground was attempted, and the first practical set evolved was a transmitter, capable of employing either speech, continuous wave, or interrupted continuous wave (subsequently called "tonic train").

It was essentially a self-contained oscillating system, to which the aerial was loosely coupled. The microphone was inserted in the earth-lead, and modulated the radiation by varying the resistance of the aerial. Some of the best ground microphones proved useless in the air, and the choice finally rested on an old-type Hunnings Cone. It is almost impossible to predict from its behaviour on the ground whether any particular microphone or type of microphone will work satisfactorily in an aeroplane; and in the Royal Air Force every individual instrument was tested actually in the air.

The set was used on a trailing aerial 250 ft. long, and employed a wave-length of approximately 300 metres, not very far removed from the natural wave-length of the aerial. In consequence, the radiation was very good. On one occasion when the author was giving a demonstration before the late Lord Kitchener at St. Omer, in February, 1916, the spoken messages were picked up and recorded by the Lowestoft interception station at a distance of over 100 miles, although the aerial current in the transmitting aerial was less than 0.25 ampere.

The author was admirably assisted in the production of this set by Lieut. (now Capt.) McDougald, R.A.F.; it was the first practical aeroplane telephone ever produced.

This transmission was at first received on the ground on a Marconi double-magnification circuit in which a single soft valve was employed for both high-frequency and low-frequency magnification, a carborundum crystal being used for rectification. The ordinary working limit of range from air to ground was about 20 miles for telephony, 30 to 35 for tonic train, and about double this distance for pure continuous-wave transmission.

The author made up a valve receiver with one soft valve, with practically similar circuits to the ground set, which was tested in the autumn of 1916, and ranges of from 30 to 50 miles were obtained from a ½-kw. spark set. It was on this receiver that intelligible speech was first heard in the air.

The overseas Forces did not for a long time make any use of air-to-ground telephony; an urgent demand arose, however, for telephonic communication between machines in the air, and all energies were devoted to solving this far more difficult problem. There was for a long time no demand for both-way working, and a machine was equipped either for transmission (for the leader to give orders), or reception (for his formation to receive them).

It was necessary to eliminate all possible adjustments; the transmitting apparatus had none, and the receiving apparatus only two, one of which was seldom touched.

A reliable, small, hard transmitting valve of French type, capable of handling about 20 watts, and similar valves with slightly more open grid for use in reception, became available.

Dealing first with the transmitting apparatus, an ordinary reaction or regenerative circuit provided the radio power, and the only electrical difficulty was the choice of the best method of applying the voice modulations. The coupled-circuit system was ruled out on account of the coupling and tuning adjustments and its output limitations.

In comparing different means of modulation, variations of intensity or output are always accompanied by some change of wave-length, and the receiver can be adapted to take advantage of one or the other factor. In practice both factors can be laid under contribution, though probably the ideal method of modulation would change intensity only.

In any system in which the change of wave-length preponderates, good or bad articulation can be produced on a reaction receiver according to the slope of the resonance curve on which the adjustment is made.

No method of controlling the radiation directly by the microphone proved free from grave disadvantages, and the choice therefore fell on some form of indirect control. The arrangement finally adopted is generally known as "choke control," in which the modulation is applied to the anode circuit of the control valve.

Let us suppose that in the anode feed circuit of a simple valve oscillator is placed the secondary winding of an ordinary step-up transformer, the primary of which is a microphone and battery circuit (fig. 1). The variations produced by the voice will give rise to changes of potential in the anode feed circuit, which will be equivalent to applying to the oscillating valve more or less high tension, and will alter the radiation in a sympathetic manner. Since, however, the energy dealt with will be weak compared with the main supply, success will be only partial. For magnifying this effect let us now introduce another or "control" valve whose grid is acted on by the original microphone transformer, and whose anode is in series with a one-to-one transformer in place of the original one (fig. 2). If the two valves are comparable and have applied to them similar high tension, we are now able to apply a modulation or variation of the same order as the energy dealt with by the first or "power" valve.

From this point easy steps take us to the actual circuit employed. The control valve can be supplied from the same source of high tension as the power valve; the transformer can become a choke coil (which is, in effect, a one-to-one transformer), and it is an obvious arrangement to work the filaments and the microphone primary circuit off the same low-tension battery.

The circuit now becomes as shown in fig. 3, in which P is the power and C the control valve, L is the choke coil, and T the microphone transformer. H T is the source of high-tension supply, and F is the filament battery.

It will be seen that the anodes of both valves draw their high-tension D.C. supply through the choke winding, and as long as the microphone is quiescent, the output and general behaviour do not differ from that of the power circuit considered as a plain one-valve oscillator. When, however, variations take place in the control-valve anode circuit at speech frequency, very large surges are set up in that of the power valve, which may approximate to the original high-tension D.C. potential and so sweep the output from nearly double its steady value to almost zero.

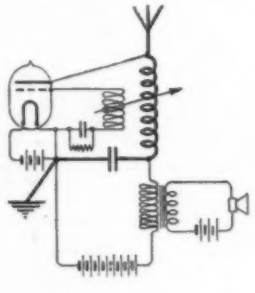


Fig. 1.

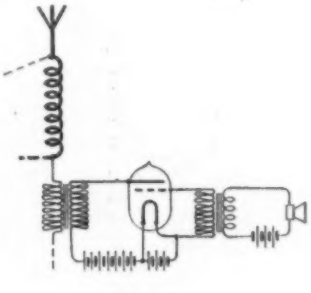


Fig. 2.

Choke control proved pre-eminently suitable for air working, and no other method of modulation survived in competition with it. There are absolutely no critical adjustments to be made. Almost every constant can be changed within quite wide limits, and though it may thus be caused to work more or less efficiently, it never reaches a point of complete failure.

The little 20-watt choke control set, designed by the author on the principles outlined above, was very successful, and became the standard R.A.F. set with which all the air transmission has, up to the present, been done.

One of its features, which was largely responsible for its success, was the use of "remote control." Things were so arranged that the set proper could be mounted at a distance in any convenient position, and only a very small control unit for operating it was brought within reach of the user's hand. In the case of the transmitter no adjustments were necessary. The control unit carried only a switch, an aerial ammeter, and plugs for microphone and telephone receiver.

The switch made or broke the dynamo field, filament, and microphone circuits, so that when it was off every circuit was dead. It was necessary merely to switch on and talk. Simplification could go no further; but how necessary this was can only be appreciated, perhaps, by those familiar with air work.

Although the first telephone had been supplied with high-tension current from dry cells, these were completely superseded by small air-driven generators, the improved descendants of one made for the author by Mr. Mackie early in 1916. The standard generator adopted gave about 600 volts from one commutator at its normal speed of 4,000 R.P.M., while the 6-volt filament accumulators were floating across the low-tension side. Moderately good electrical regulation was provided by a demagnetising field-winding system, and in this way the size of the accumulator had not to be very great.

It was found to be highly important that the speaker should be able to hear the effect of his own voice, and to do this in the simplest possible way a condenser was placed in the earth lead, and across it a pair of head receivers was connected, which were thus enabled to pick up the low-frequency effect. By connecting another pair in parallel, the other occupant of the aeroplane could also hear what orders were given.

Mechanical disturbance of the microphone is almost completely eliminated by holding the microphone in the hand—the finest possible shock absorber. The acoustical difficulties are far worse, as the noises which it is desirable to reject are of the same order as the sounds that are to be accepted.

After much experiment the Gordian knot was cut by devising a microphone almost insensitive to sounds of the noise intensity, but responsive to the powerful concentrated sound waves of a voice impinging upon it from a very short distance. The voice was raised to a higher power, as it were, by speaking very loudly, and thus two distinct orders of intensity were produced, which could be separated. By choosing a suitable thickness of diaphragm, size of granule, tightness of packing, &c., combined with heavy damping, a satisfactory microphone was arrived at. It appeared curiously dead and ineffective on the ground, but seemed to take on a new sprightliness in the air.

We now turn from transmitting to its complement, receiving in the air. When the general uproar is remembered, the difficulties need no emphasis. The problem here was to combine considerable sensitiveness, loud signals free from distortion, and the minimum of adjustment.

The arrangement which, as the fittest, survived, consisted essentially of a detector valve with reaction, and two note magnifications. The detector valve was not energised direct from the aerial, but through a so-called "aperiodic" circuit, which was really a circuit approximately syntonised by its self-capacity. This has always been found to reduce magneto noise considerably.

In some air-trials with the early 1916 soft-valve receiver, it was noticed that to alter the filament brightness made a very convenient way of finally controlling the reaction, after the circuit had been set near the critical point.

In spite of the diminished radiation of such an aerial, the increased sensibility of this receiver approximately restored the usual range. Fig. 5 represents a typical circuit of this kind and shows one high and one low-frequency magnification, with a fine-grid rectifying valve between. Increased sensitivity as well as the nearer average approach of the aerial system to the source of disturbance, made more apparent, however, one of the great bugbears of air work where great sensitiveness is necessary—magneto noise.

Since the new type of receiver had not come into general use up to the time of the armistice, all the actual work was done with the three-valve receiver and transmitter already described. Trailing aerial wires of 120 ft. length were used in the transmitting machines, with an aerial current of the order of 0.4 ampere, while the receiving machines had aerials 80 to 100 ft. in length. The normal safe working range from machine to machine was about 4 miles (though this was often very much exceeded), while the range to a ground station was from 20 to 50 miles or more.

A squadron of machines equipped with this apparatus could set out and fight or manœuvre in formation under the orders of their commander, whose machine only was fitted for transmission. So great was the importance of telephony considered to be, that a special school of wireless telephony was instituted under Capt. Furnival.

A demand for both-way working was easily satisfied by fitting both the standard sets in all necessary machines and arranging some form of switch-over.

In consequence of the greater ease of reception at a quiet ground station, and its superior transmitting power, the to-and-fro ranges became approximately equalised, in spite of the disparity of output, and a machine could speak or be spoken to at distances of the order of 70 to 100 miles.

In the most recent apparatus with which the author is concerned, the transmitter will deal with an input of 100 watts, and choke control will be retained. All types of transmission will be provided for. The receiver will have three high-frequency magnifications and one low, making with the detector five valves, and the combined transmitter and receiver will be worked from one remote control. Batteries will have to be retained at present for filament lighting, but they can be small ones floating across the generator; and there seems good reason to hope that in the near future a perfectly silenced and regulated generator will permit of the abolition of the battery, all current, even for the receiver, being supplied direct from the dynamo.

Ground stations will be equipped for direction-finding with a transmitting mast one or two hundred yards away controlled from the receiving building, and matters will probably be so arranged that the ordinary P.O. land lines can be plugged direct on to the wireless, so that a man may talk direct from his office to a machine in the air.

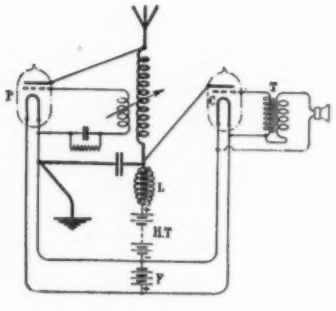


Fig. 3.

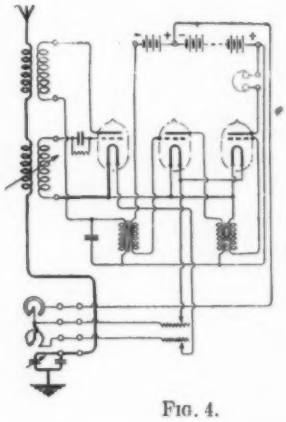


Fig. 4.

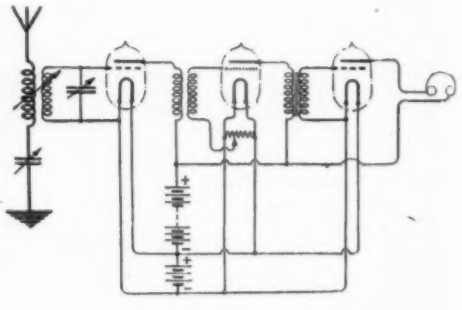


Fig. 5.

The principle involved is that the increase in emission caused by brightening the filament of the detector valve, whose anode current is concerned in the reaction, steepens the characteristic curve and so determines the oscillatory condition, when the circuits have been adjusted near the critical point; to alter the reaction electrically in this way makes but an infinitesimal change in wave-length, whereas in mechanical methods small changes of capacity are inevitable with every adjustment.

The remainder of the receiving circuits will be clearly understood from fig. 4.

Prior to the war high-frequency magnification by resonance methods had been in use; transformers with an iron core, highly laminated, were employed to deal with wireless frequencies, and worked efficiently over large ranges of wave lengths. Capt. Round showed how all such transformers could be considered to be essentially resonance transformers, differing only in damping. Special low-capacity valves were introduced, so that the damping produced by them could be made a maximum, and high-frequency magnification was tamed and harnessed. A cascade series of such valves could be set up, working with fairly constant efficiency over a large range of wave-length, so that no tuning (within these limits) was needful except that of the circuit applied to them.

The first fruit of this advance, as far as aircraft sets were concerned, was a five-valve receiver, designed by Major Whiddington, in which a choice was made of two high-frequency magnifications and two low, with a detector valve. This set was, as compared with the former three-valve receiver, about ten times as sensitive for strong signals, and 30 times for weak ones.

It was intended for use with fixed aerials rigidly connected to the wings and fuselage of the aeroplane—as opposed to the trailing aerial, which was a great embarrassment in fighting.

Research at the P.T.R.—During 1918 the Physikalisch-Technische Reichsanstalt determined the coefficients of electrical resistance of a large number of pure metals in the form of wire, between — 192° C. and 500° C. The results are not given in the abstract reproduced in *Ztschr. des Vereines deutscher Ingenieure* for January 31st, 1920. Four kinds of aluminium of varying degrees of purity were investigated, and the coefficients of resistance determined between 0° C. and 100° C., and at various temperatures up to 600° C. At 250° C. the greatest conductivity and the highest temperature coefficient were found. The coefficient of resistance of aluminium tested under these conditions was found to be practically unaffected by impurities in the metal. The thermal expansion between — 78° C. and 500° C., and the breaking strength were also determined in the case of aluminium. The expansion of two samples of 98·8 per cent. and 99·6 per cent. purity respectively, within the limits of temperature mentioned, can be expressed by the equation—

$$l_t = l_0 \{1 + (22{\cdot}9\, t + 0{\cdot}009\, t^2)\, 10^{-6}\}.$$

BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION.

The annual general meeting of the above Association took place at the offices in Kingsway, W.C. 2, on Thursday, March 18th, Mr. W. O. Smith, chairman of the Council, presiding.

As has now become the usual thing with the B.E.A.M.A., the Press was not invited to the meeting, but we are officially informed that the certified income and expenditure account and balance sheet for the financial year ending September 30th, 1919, were adopted, and that in presenting the annual report the chairman referred to the election of the late chairman, Mr. Davenport, to be a vice-president of the Association. Unfortunately, he had to absent himself from subsequent meetings, as he was attacked by an illness from which he had not even yet completely recovered. They hoped he might be shortly restored to health again, and able to resume his work.

The Council had had a busy year. The change-over from war to peace conditions had brought with it many problems requiring careful consideration. Although it was not within the province of the Association to deal with labour and wage questions, they must recognise that labour difficulties during the year, including the recent strike of moulders, had had their effect on all industries. Coupled with the general increase in wages, the shortage of materials, and general unrest, industry had been prevented from reaping the full benefit to be expected from a victorious ending of five years of war. They hoped that reason would at length prevail, and that some path would soon be found along which employers and employed might march side by side, and thus enable the country to emerge from the period of darkness, and to attain, once more, to the proud position which it held for so many years as the leader of commerce.

The chairman then reviewed in detail the work of the Association during the year, as recorded in the report, particularly noting the excellent work done by certain committees, *e.g.*, the Overseas, Education, Standardisation, and Traffic Committees. On the subject of research, he said that the work of the Electrical Research Committee was at present somewhat restricted through lack of funds. Given the necessary funds, and the consequent Government grant, existing researches could be carried on expeditiously, and much work in contemplation could be put in hand. The Council had given very careful consideration to the subject, and had arrived at the conclusion that collective research was not only desirable but necessary in the interests of the industry, if they were even to keep pace with other countries, already well organised for research. In order to obtain Government grants of £1 for £1, a large sum per annum for five years would have to be guaranteed. The Council was of opinion that this sum should be found by the industry, and strongly recommended that to the sections of the Association. Referring to the recently appointed Committee of Chairmen of Sections, he said that it should do good work, and would be assisted by the Council's decision to issue to its members the Council's minutes, with permission to report to sections anything of special interest to them. On the subject of increased accommodation, he said that the Council had been compelled, owing to the increase of staff, the sectional activities, and the large number of committee meetings now held, to enlarge the office accommodation. They were now in possession of several additional Committee rooms. That, of course, entailed increased rent, but the Council had been mindful of the interests of the smaller firms, and had not varied their subscriptions in any way. The increase of the maximum subscription would affect the larger firms only. He was glad to say that some of the larger firms had already come forward and expressed their intention of paying the maximum subscription regardless of wages.

The report was adopted.

The chairman then announced the result of the ballot to fill the vacancies on the Council for 1920, as follows: The elected members were:—

The British Thomson-Houston Co., Ltd.
Brook, Hirst & Co., Ltd.
Browett, Lindley & Co., Ltd.
The English Electric Co., Ltd.
The General Electric Co., Ltd.

Messrs. Price, Waterhouse & Co. having been re-elected auditors, the proceedings terminated with a vote of thanks to the chairman for presiding.

We give the following extracts from the report of the Council for the year 1919:—

The B.E.A.M.A. is a peace organisation; but no better test of the strength of any organisation can be applied than the way in which it passes through the fires of war. The B.E.A.M.A. emerges from the war stronger than ever. . . . Now that we are confronted squarely with all the problems of peace, you have, in the B.E.A.M.A., an organisation tested by war, and qualified to deal with any emergency.

Of those problems none is more important than export business. Export inquiries have been secured sufficient practically to absorb members' whole productive capacity. But the home demand has also been such as to call upon their utmost capacity to meet it, and there the danger lies. It is easier and, in a sense, more immediately advantageous to do the home business, but, clearly, the big home demand cannot last for ever. Just as clearly, if the export demand is not met and connections are not kept up, even in the face of keen foreign competition, there is a grave danger of losing the future world markets upon which, at no very distant date, when home orders diminish, everything will depend.

The Council therefore strongly recommend that the greatest effort, even to the sacrifice of a portion of the home market, should be made to go vigorously into the markets abroad, to secure and keep alive all overseas connections, and to increase the volume of business, which must gradually grow to be very much above the pre-war level if the future is to be properly secured. Evidence is not wanting that export matters now occupy a large place in the minds of members. In no previous year has the Association entertained so many visitors from overseas. The results of these visits have been promptly communicated to members, in addition to special reports regarding trade in Spain, Scandinavia, Japan, Brazil, the Argentine, Canada, India, and China.

With regard to the work of the Overseas Committees: During the year the Argentine Committee issued to the British Legation, through the British Chamber of Commerce, in Buenos Ayres, a comprehensive report on business in the Argentine. The South Africa and Australia Committees have been active in ensuring reasonable conditions of contract for members; and the latter committee has also done good work connected with the proposed revision of the Commonwealth tariff, the arbitrary loading of invoices by the Customs authorities (regarding which a new Bill has now been introduced); and on a new Act of the Victorian Parliament requiring certain goods to be marked with the name of the country of origin. The India Committee has had the great advantage of the personal assistance of H.M. Trade Commissioner, Mr. T. M. Ainscough, O.B.E., and has furnished to the Director of Statistics, who has put into use, extended schedules classifying sea-borne electrical imports to India. This committee has, further, ensured that greater consideration shall in future be given to members in all work connected with the development of the many hydroelectric schemes now in prospect in the various States, in which connection the Government of India through the India Office has accepted from your Council a recommendation that the British standard frequencies of 50 and 25 cycles per second should be adopted for all hydro-electric and other alternating-current schemes in India. Many promising activities of these and other Overseas Committees have been delayed by the necessary return to England of the officers who held these outposts of British trade during the war.

The Board of Trade adopted a new classification of imports and exports based upon proposals furnished to them by your Association, and contributed to by almost every section of it. The new classification will exhibit increased lists both for incoming and outgoing manufactures.

The need for a sound and comprehensive cable code, providing specially for the electrical and allied industries, has been long felt; and your Council have given their provisional assent, with the support of members, to arrangements for the preparation of such a code.

The Department of Overseas Trade sent a British Engineering Commission, on which your Association was represented, to the occupied area of Germany, and the resulting report (I.M. 3612/19) was circulated free to members.

Your Council have noted with regret the sharp impact of political exigency on many of those excellent resolutions and counsels of wisdom (Government Committee reports on after-war trade), which, during the war, so stirred the nation as to evoke promise of their fulfilment from the Government. The promised restriction of foreign imports has gone, and, judging from the reception given by the country to the Anti-Dumping Bill, the restriction even of dumped goods cannot be looked forward to with much certainty. The influence of the foreigner has not been slow in making itself felt in municipal business, and the Board of Trade has no power to compel the adherence of municipalities to its recommendation to purchase only British goods. Save as to the Government's success with the Education Act, its financial assistance to research, its promised assistance to standardisation, and the passage into law of the Electricity (Supply) Act, all may be said to be left again to private effort; and reforms are to be expected only by such pressure as associations like your own may be able to exercise. Nothing could better illustrate the devious nature of Government "policy" on fundamental questions than their post-armistice actions in the matter of import restrictions.

The report prepared by your Education Committee entitled "Education and Training for the Electrical and Allied Engineering Industries" was completed, and your Council authorised its publication. There is little question that this, the first practical effort towards systematising work in so promising a field, will not fail of effect. The Education Committee has now well in hand the deferred subject of provision for overseas students, and the scheme for the founding of studentships and scholarships offered by the turbine and turbo-generator sections of the Association for the study of problems of research relating to turbines and turbine-driven generators. These scholarships are being projected to encourage technically trained students to fit themselves for posts on the higher staffs of engineering concerns and research institutions, and such men will to some extent relieve the apparent shortage of suitably trained technical engineers.

The work of the Research Committee of the Association has been somewhat overshadowed during the year by that of the new representative body, the Electrical Research Committee, in which your Association, the Institution of Electrical Engineers, and the Committee of the Privy Council for Scientific and Industrial Research (Mr. Arthur Balfour, president), are the partners. That body now purports to cover not only all the researches previously conducted by your Association and the I.E.E. jointly, but to undertake all new work demanded by any section of the Association or by the profession. Mr. E. B. Wedmore was appointed its director, and commenced his duties on July 1st. As a result, the work in hand has been brought into a state of great activity, and a largely extended programme of new work has been laid down.

There is no question as to the value of this work. It must result in progressive reductions in the cost of plant, in its more effective use, and the elimination of defects both in machinery and raw materials. But in order to secure substantial assistance from the State, adequate guarantees of support must first come from manufacturers. We have a great deal of leeway to make up if Great Britain is to be put even on a level with America and the Continent. Only by the collective action of associated firms can such work be carried out effectively, most of the vital problems being too large for the efforts of any individual concern. Your Council, therefore, strongly recommend the Electrical Research Committee for the support of members of the Association.

The separate research into the corrosion of condenser tubes carried on jointly by your Association and the Institute of Metals, is reaching a stage when it will be possible to communicate important results to the contributors. Research into the most suitable materials for turbine blades and nozzles revealed at an early stage the importance of the metallurgical examination of materials; and arrangements have been made with the National Physical Laboratory for carrying out this work, for which the blades for test are being provided free of charge by the makers. Another turbine research is that of nozzle proportions, and arrangements for co-operating with the Institution of Mechanical Engineers in this research are now complete.

The B.E.A.M.A. publication, *Standardisation Rules for Electrical Machinery*, first published in 1913, has gradually won its way to popular favour as the standard work in its class. It reached its fourth edition early this year, and is, in that revised form, now the subject of discussion between various university authorities and technical colleges and your Association as to its adoption by the former as a handbook for the instruction of students.

The year has disclosed no diminution of the spirit of goodwill on the part of municipal engineers in settling their contracts on the I.E.E. model conditions, or such other reasonable equivalent as might be necessitated by subject matter.

Your Revising Committee, which has charge of the I.E.E. text, recently proposed certain amendments to your Council, and the Institution, to which these amendments were at once taken, considered them important enough to warrant the creation of a special committee of revision jointly and equally representative of the purchasing and manufacturing sides of the industry. It is hoped that this joint committee will sit permanently to consider amendments proposed by either side from time to time.

The sets of conditions of sale A and B for home work and AE, BE, and AEC for export work continue to set the standard practice for the whole trade, and are always in brisk demand.

The text of "Instruction for the Use and Conditions of Sale and Contract" was amended during the year by the addition of railway companies to the list of those purchasers from whom the Association's conditions must be obtained. The proposal was made to the companies on May 12th, inviting objection, and, none having been received, the rule was put into force on August 12th.

Translations of the Association's sets of conditions of sale for export work are now available in French and Russian.

In July last your Council set up a Traffic Committee which attended before the Railway Clearing House on September 25th, 1919, and gave evidence in support of a claim that slide rails and bedplates for dynamos and motors should be placed in a lower classification. The application was successful, the railway companies lowering the classification from 3y to 1m, a concession of considerable value, as the tonnage in this class of goods is approximately 20,000 per annum, and the saving in freight considerable.

Immediately upon the announcement of the proposal to increase goods rates by 50 per cent., the committee passed, and the Council sent, a protest to the Minister of Transport against all-round increases of this nature. The committee recognised the necessity for raising rates in order to meet the increased cost of transport, but recommended that instead of an all-round increase of 50 per cent. it should be on a graduated scale so devised that raw materials should bear the lightest burden. It was specifically recommended that the maximum increases for the classes covering raw and semi-raw materials should be as follows: Class A, 2s., class B, 2s. 6d., and class C, 3s. 6d. per ton. Two of the maximum increases which came into force on January 15th, 1920 were almost identical with the recommendations, the third to be without maximum, but on a graduated scale as recommended. At the date of going to press with this report there was an entire lack of uniformity in the manner of charging the new rates, not only by different railway companies, but by the local goods departments of the same company. The Traffic Committee has this matter now under consideration, and will shortly make recommendations directed at systematising the companies' practices. That committee also gave consideration to the question of demurrage, both in respect of private sidings and on the premises of the Port of London Authority, and on its recommendation your Council supported an F.B.I. proposal to challenge by means of a test case, the railway companies' action in this matter. This committee is, further, preparing evidence in support of an application for a revision of the classification of electrical machinery and apparatus generally. On the initiative of the committee, your Council was able to obtain concessions in freight rates for electrical machinery and apparatus to Australian ports. The Ministry of Transport has accepted from your Council the nomination of four members for seats on the panel of experts set up under section 23 of the Ministry of Transport Act.

Brief reference is made to the Electrical Development Association. Mr. J. W. Beauchamp, director and secretary, will welcome inquiries as to its scope and work. The Council recommend the E.D.A. to the attention of every member who has the future of the industry at heart.

The scientific and telegraph instrument section of the Association, with commendable enterprise, devised and adopted a mark for their apparatus showing the initials of the Association over-printed with the words SATIS, being the initials of the section. Your Council are now in correspondence with the Board of Trade as to a licence for the use by all members of the same or a similar mark for members' electrical manufactures of all descriptions.

A Committee of Chairmen of Sections has been appointed to provide for the better co-ordination of work common to, and the exchange of ideas between, sections.

Your Council has considered it expedient to defer the holding of a special B.E.A.M.A. Exhibition in London till 1922.

The following new sections were constituted and began work during the year: The Cooling Water Apparatus Section, the Gas and Oil Engine Section, the Reciprocating Compressor Section.

The system of tendering embodied in the cross-tendering agreements continues to find favour among members, but has not been extended. The condenser cross-tendering agreement was revised during the year so as to make it applicable to all inquiries whether publicly advertised or not.

In order to meet the increase of rent and general increase of staff and other expenses, your Council has had under consideration the question of increasing revenue by additional subscription. The Council decided as a preliminary measure, to raise the maximum subscription from the present figure of £200 to a new maximum of £500.

The annual dinner will be held this year on May 20th.

The report refers to the close working relations of the B.E.A.M.A. with the F.B.I., and to co-operative working with other bodies.

The number of members on the register at the end of the year was 225. Nineteen members were admitted to membership during that period and ten resigned. Of these resignations six were accounted for by amalgamation or reconstruction.

Australian Company.—The Australian papers state that a meeting of shareholders in Standard Waygood Hercules, Ltd., was held on February 3rd to alter the name of the company to the English Electric Co. of Australia, Ltd., and to increase the capital of the company to £600,000. Mr. G. A. Weymouth was to be appointed managing director, in which capacity he had been acting for some time. The programme of the company is an ambitious one involving great extension of the works in Australia. It is described as a virtual amalgamation with the English Electric Co., Ltd.

Prices of German Wires and Cables.—Quoting from a German paper, the *Economic Review* states that as from March 1st, the Price Section of the Central Association of the German Electro-Technical Industry ceased to publish increased metal prices for cables and wires. From that date, the prices for insulating wires are reckoned on the basis of the bi-weekly quotations for copper and aluminium, and vary with the fluctuations in the basic prices of these of Mk. 2,500 and Mk. 3,000 respectively per 100 kg.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Xcel" Utility Electric Cooker.

As an all-British production, the "Xcel" utility electric cooker, of which Messrs. Drake & Gorham Wholesale, Ltd., 67, Long Acre, W.C.2, have sent us particulars, deserves notice. This cooker, fig. 1, which is particularly adaptable to the many forms of cooking, *i.e.*, grilling, toasting, boiling, &c., consists of a heat together with a pan, grill, and deflector. It is nickel plated, highly finished, and can be used on a dining-room table, being supplied from an ordinary lighting circuit. The heater loading is 600 watts.

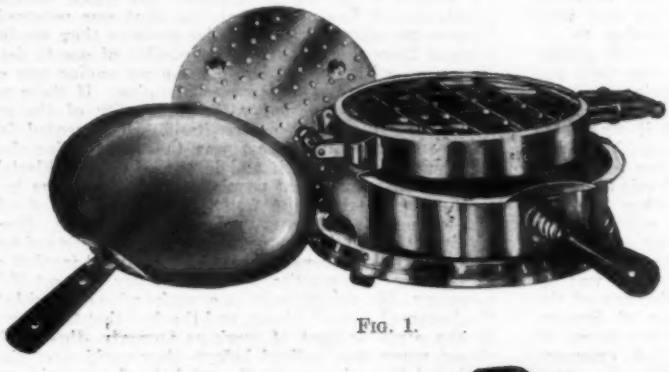


Fig. 1.

Fig. 2.

Fig. 3.

The "Xcel" Utility Electric Cooker.

By means of this apparatus, two cooking operations can be carried out at once. Fig. 2 shows steak and potatoes being cooked in two utensils, and fig. 3 illustrates potatoes being boiled at the same time as fish is being cooked.

Other agents for this cooker are Messrs. Siemens Bros., Messrs. Down & Davies, The Electrical Supplies, Berry's Electric Co., and the Sun Electrical Co.

The "W.R." CO_2 Indicator.

The importance of easily and correctly ascertaining the percentage of CO_2 in boiler flue gases, in order that fuel may be consumed to the best possible advantage, is now fully realised. The "W.R." indicator, which has been mentioned in several of our recent articles, and appears to be increasing in popularity, overcomes, it is claimed, many disadvantages of previous instruments. By its help it is said to be possible to maintain an average of 14 per cent. of CO_2 in the flue gases. With a flue gas exhaust temperature of 500 deg. F., by increasing the percentage of CO_2 from 6 to 12 per cent., a 13 per cent. saving in fuel can be effected, so that the usefulness of an apparatus of the above description will be obvious. Perfect combustion would show about 19 per cent. of CO_2, and while 17 per cent. is obtainable with the help of the W.R. indicator, the average figure is 14 per cent., which means with the average plant a saving of from 10 to 15 per cent. on the coal bill. The instrument, fig. 4, indicates by the height of a water column on a gauge glass tube and the fireman can thus see at a glance what adjustment of his dampers is necessary to maintain the highest average of CO_2 in the furnace. The device is quite simple, there are no moving parts in it, and it is stated that it is within 1 per cent. of absolute accuracy, and that it will last as long as a boiler. When dirty it may be swilled out with a bucket of water. The action of the indicator is as follows: An aspirator worked by a small jet of steam continuously aspires gases from the flue which it is desired to keep under observation. The path of the gases is indicated by the arrows in fig. 5. The pipe A may be connected to an induced draught fan if more convenient than connecting it to the aspirator.

The sample of gas is first drawn down the glass tube and passes through the water at the bottom of the instrument. It then percolates through the filtering material, eventually entering the upper chamber containing the porous pot, in the interior of which is the reagent. A small pipe connects the interior of the porous pot to the top of the recording gauge glass G, which is connected at the bottom to the water space. Some of the gases passing through the upper chamber penetrate into the porous pot and are absorbed by the reagent. A partial vacuum is thus formed, varying in intensity according to the percentage of CO_2 contained in the gases passing at the time. By this means the water is forced up the gauge glass tube, which is graduated to read directly in CO_2 percentages. The whole instrument occupies little space, and is particularly robust, accurate, and reliable. The apparatus requires practically no attention, except that a fresh cartridge has to be inserted in the porous pot every twenty-four hours, and about once a month the main filter and flue piping should be thoroughly cleared of soot. The instrument reads continuously, has very little time lag, and answers readily and rapidly to any variations. The makers are Messrs. "W.R." Patents, Ltd., of 8, Old Jewry, Cheapside, E.C. 2.

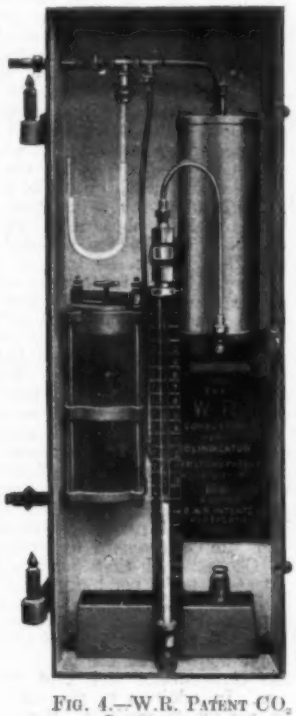


Fig. 4.—W.R. Patent CO_2 Indicator.

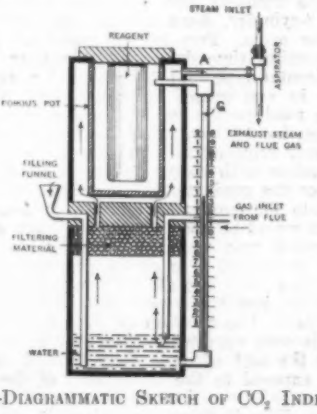


Fig. 5.—Diagrammatic Sketch of CO_2 Indicator.

BY-PRODUCT PRODUCER & BLAST FURNACE GASES.

At Manchester, on March 9th, Mr. W. H. Patchell's and Mr. S. H. Fowles' papers (abstracts of which appeared in our issues of March 19th and 26th respectively) were read and discussed before the North-Western Centre of the Institution of Electrical Engineers.

Mr. Pilling said it must be a revelation to electrical engineers to have gas engines brought prominently before their notice at this time. Many of them, and many steam engineers also, had an idea that the day of the gas engine was past, but during the war great developments had taken place. Largely because German competition had ceased, quite a large number of gas engines of considerable power had been made in this country for electricity generation and air blowing. It seemed clear from the papers that openings for development existed both with producer gas and with blast-furnace gas. It was extremely disappointing to an engine maker who had turned out engines of good quality to know that the good results obtained in one case were not repeated in another. It depended on the efficiency of the gas-producer plant. With the Halberg-Beth dry cleaning process uniformly clean gas could be obtained if reasonable attention was given by the engineer in charge. With the Halberg-Beth plant the gas could be made more pure than air. These facts pointed to the necessity of cleaning the air as well as the gas, and he had no doubt that when this was done an engine would be able to run for a much longer period without having to be stopped for cleaning. He knew no mechanical or physical reason why it should not run for an absolutely indefinite period if efficient plant was installed. In choosing the type of engine the decision of the purchaser appeared to turn upon the question of finance. As a rule a firm which had plenty of money was more inclined to take the low-speed set; if they had extensive demands on their capital and had an exceptionally large programme to carry out, the decision was apt to turn in favour of the high-speed set. For a given power it was cheaper to make a high-speed, multi-cylinder gas engine than to make a low-speed one, and, moreover, the former occupied less floor space. So the whole question seemed to turn upon finance, and the makers of low-speed engines had to face that difficulty. There was no difficulty in producing 3,000-h.p. with a 2-cylinder engine, and 6,000-h.p. with 4-cylinder engines. It was highly probable if the price of coal continued to rise that blast-furnace plant would be compulsorily used by order of the Government to produce blast-furnace gas.

Mr. Glover said that years ago when slack was being bought at 6s. to 8s. per ton, and with sulphate of ammonia at approximately £10 per ton, one could recover all the cost of gasification and something more on the by-products. But to-day, while coal was approximately 30s. a ton, sulphate of ammonia was sold at £19 per ton. The price was controlled by the Government and kept low for the benefit of the farmers. In addition to the price of the coal, it cost 10s. to 15s. per ton to gasify it. For these reasons the gas engine consuming producer gas was not now a tempting proposition, if power production was the only consideration; but other arguments might be found for it. For instance, the gas might be used in furnaces. However, there was a great economy obtainable from the gas engine using blast-furnace gas. From the electrical engineer's point of view, gas engines had a very undesirable failing. Sulphuric acid got into the engine room and attacked all electrical connections. A kind of oily vapour mixed with the sulphurous fumes was deposited on the windings, and there was a liability to short circuit. The 8-cylinder, 4-crank type gave extremely good results in some cases. Two had averaged 90 per cent. of the possible running time day and night over seven years. The large horizontal type had not so good a record. Little troubles crept in and caused stoppages, and when a large amount of the total power was put into one set there was a greater proportionate loss. An important factor was the amount of labour required for working gas engines and gas plant in comparison with steam turbines. He estimated that with the former the production of 1¼ million units per week would necessitate the employment of approximately 150 men, with turbines it would be about 30 men. When an absolutely even power supply was wanted difficulties cropped up. If the men could be trained to work the producers, in step as it were, so that they were not all poking at the same time, it would be all right, but it was very difficult to get the men to work in that way. The question of the ash in coal was also important. His own experience was that it was very difficult to obtain the sort of coals they wanted. If automatic switches were exposed to the atmosphere of the gas engine, there was a corroding action, and a deposit was formed. Tar was a very difficult thing to deal with. It had an unfortunate property of depositing at every change of temperature. The only way was to reduce the temperature to the lowest degree which it would reach at any point of the system afterwards; then they could be certain there would be no further deposit of tar. He doubted very much whether it was now an economic proposition to produce power from bituminous coal in gas producers.

Mr. T. R. Wollaston agreed that the waste gas from coke ovens ought to be utilised, but looking at the subject from the point of view of producing a large amount of electricity, coke-oven gas was an impossible proposition. In order to get it in that way, more coke would have to be produced than the whole world wanted. There were possibilities in low temperature distillation from the point of view of the production of benzol, but he saw no prospect of producing any large amount of electricity. He agreed with Mr. Pilling that the questions of capital cost and amount of floor space needed were factors in the choice between the gas engine and the turbine. He had great faith in the future of producer gas for firing boilers, even at the present prices of coal and sulphate of ammonia.

Mr. J. G. Walthew said it entirely depended on the type of gas engine whether sulphurous fumes would effect the electrical equipment. With the enclosed vertical type it was not possible for the fumes to escape and get into the engine room. If gas got into the crank chamber it was drawn away by means of a small exhauster fan which maintained a circulation of free air. When the dust was removed blast-furnace gas offered a much easier problem than producer gas because there was a fairly even quality of gas to deal with. He agreed with Mr. Fowles that the gas engine was quite as good a prime mover as the steam engine. If there was any trouble it was connected with the quality of the gas, and not attributable to the engine itself. He dissented from the statement that capital cost was the determining factor in the choice between high and low-speed types. Electrical engineers and power plant people generally would go in for the most satisfactory machine from the point of view of reliability and economy, irrespective of the capital cost. One cause of dissatisfaction in the past was insufficient stand-by plant. A power station should be properly equipped in that respect, so as to be in a position to overhaul any one set if it were necessary. He was recently at a works where notwithstanding the increased cost of labour, and the fact that the men did not do the same amount of work as formerly—three being employed where two sufficed before—they could meet the whole of their labour charges by the sulphate of ammonia recovered.

Mr. Fennell said the corrosion due to gas fumes escaping could be remedied. A great help was to grease the contacts with vaseline. An undertaking which used South Staffordshire Mond gas had as much trouble with the enclosed type of engine as with the open type. The fumes escaped from the crank chamber and were churned up by the flywheel. If an exhauster fan were used, as one speaker had suggested, the oil consumption went up by leaps and bounds. It was a curious thing that some plant produced a much greater quantity of tar than others. At Northwich, within a quarter of a mile from the Mond gas station, they had no trouble from that cause; at a South Staffordshire works, over four miles from the Mond gas station, there were quantities of tar, and the trouble was got over by reducing the temperature of the incoming gas to a level below which it would never go again. Mr. Fowles had made an excellent case for the use of gas engines, but, of course, they were up against present-day conditions. He had recently had occasion to go into the question of producer gas, and he found it paid to put down a non-recovery plant or anthracite plant in sizes anywhere near 1,000 h.p. and larger. He believed it was a fact that the price of anthracite had not increased in the same ratio as that of ordinary coal.

Mr. Patchell, in replying, said it was not quite a fact that the high-speed steam engine had been ousted by the low-speed type, but the field for it was certainly limited. His own feeling was that 1,500 h.p. was too large. Its limitations had been masked by the development of the turbine. Of course, the capital cost was a very important matter. At pre-war prices the steam turbine cost so little that practically fuel was the only thing that mattered, but the cost of a big plant for Birmingham Corporation now came to £45 per kw. A great deal could be said about the effect of gas on electrical equipment, and Mr. Pilling's statement that the gas was cleaner than the air was absolutely applicable to some of the old stations. In connection with two of the engines dealt with in the paper, forced lubrication was introduced. A fan blew air through the open casing, and by an open port in the crank chamber it entered the air inlet of the engine, so that it was constantly sucking air through. He was astonished at the quantity of oil that went through. He should not have thought there was so much more oil floating about in the crank chamber with forced lubrication than with the banjo system of lubrication. They had absolutely no trouble with fumes in the engine room, and the engines ran quite as regularly as steam engines, and were as clean.

Mr. Fowles said they had had no trouble from fumes affecting the electrical connections. He thought much depended upon the type of engine, whether it was open or enclosed, and also how the men were looking after the machinery, and how the employers looked after the men. Mr. Glover had said 150 men would be needed to produce 1¼ million units per week. That figure was altogether too high. His experience was that both high and the low-speed engines were good in the right place, and one was as easily started as the other. On the stand-by question, again a great deal depended on how the men looked after the engine. They had not used vaseline, nor had they found it necessary to put an exhauster fan on the crank case. All the engines used forced lubrication.

LARGE POWER TRANSFORMERS.

At a meeting of the Western Centre of the Institution of Electrical Engineers the paper by Messrs. A. G. Ellis and J. L. Thompson on "Large Power Transformers" (which was abstracted in our issues of May 9th and 16th, 1919) was read.

In the subsequent discussion Mr. Arthur Ellis (Chairman) said the subject of the paper was somewhat difficult to discuss, as most of them who had to utilise transformers, no matter what size, were more concerned in obtaining transformers which would comply with the conditions under which they would have to work, leaving to gentlemen like the authors to work out the details of construction. The authors referred to lack of opportunities for building large transformers, but he thought those opportunities would be amply afforded in the future under the new scheme of production and distribution generally. Manufacturers would produce transformers of large power in view of the larger units which were going to be utilised for public supply, and so long as the transformers were properly designed there was no reason why engineers should not rely equally upon transformer units as upon generating units. The authors suggested that crane capacity was a limiting factor in the production of large designs, but the installation of larger units would no doubt influence the production of bigger capacity cranes. He did not think it needed much understanding that transformers above 5,000 kw. should be forced cooled—some might suggest that those of smaller capacity should be so treated. He considered the core type had many advantages over the shell type. The authors suggested that the correct method of switching in was to slowly close the switch. Were the authors satisfied that no injurious effects would result to terminals by this method? He agreed that the British Engineering Standards ought to be adopted, and that the different designers of transformers should pool their designs.

Mr. W. A. Chamen said he did not quite know why he was expected to say that 25 cycle transformers were better than any other. What he did say was that they had a large number of 25 cycle gear installed, and he did not quite see how they were going to get rid of it. He considered the cost of the transformer was not everything, but if it were such an important thing why not go to 100 cycles? He thought a great deal too much was made of the supposed advantages of 50 cycles, and he did not know how it came to be adopted. It might be of interest to know that there was actually a proposal to give a supply in that district at 15 cycles. All he had to say was they had 25 cycles and 50 cycles, and the problem was how to work the two together or how to gradually make the change over so that there should be only one frequency. With all the brain work that had been expended on transformers he wondered why someone had not devised a static frequency changer. He was very glad to hear the authors' remarks on auto-transformers. He went into this question himself some years ago and arrived at the conclusion that they were most dangerous to use. He would like to know whether the automatic device for taking up the slack of contraction or shrinkage of the insulating material had been put to the test.

Mr. Lewis said there was one thing Mr. Ellis had not touched upon, and that was a straining tank wherein the oil circulated and some chemical was used to remove the moisture from it. Perhaps Mr. Ellis could let them know something about it.

Mr. A. J. Newman said that although the paper had been written something like a year ago, progress had not been so rapid as to cause the data given to be in any way out of date. He would like to know how much in the authors' opinion the costs per k.v.a. had been increased since the figures were compiled. During the war it was no unusual sight to see large pieces of machinery transported along main roads, and in his opinion a few remarks on the limit of the carrying capacity of some of the main roads would not have been out of place. The authors gave no particulars of weather-proof transformers suitable for use in the open. He understood it was common practice in Canada to install both transformers and switchgear without any protection from the weather whatever. No mention appeared to be made of utilising the latent heat of vaporisation of water in dissipating the heat due to losses in transformers. Personally, he had never favoured 3-phase transformers owing to the difficulty in handling, loss in efficiency, and greater cost when spares were taken into account. One had to agree that there was a great saving in floor space, but one must not lose sight of the fact that the external connections in the case of single-phase transformers are not easy to deal with, and are indeed a costly item. Was it not true that there was a greater difference in the case of a 3-phase transformer between the hottest point and the average temperature of the oil? On page 12 he noticed the authors made no differentiation between the annual charges in respect of iron and those pertaining to copper losses. An old time figure he remembered using was 1s. per watt for iron losses, but this was based on ¼d. per unit for 100 per cent. load factor units. If they took the authors' figure of ¾d. and present day value of money the 1s. above referred to became something like 2s. 8d. per watt. Now, comparing the single-phase and 3-phase proposition, they had 5 kw. iron loss in favour of the single-phase proposition. This at 2s. 8d. per watt was equal to £666, a fairly substantial item amounting as it did to about 12½ per cent. of the cost of the 3-phase transformers, and more than adequate to provide the extra expenses of external connections.

Major David said he noticed that the cost of the self-cooled transformer assumed a very flat state above the 5,000 k.v.a., so there was really no saving in larger units. The weights also increased for machines above 3,000 k.v.a., and no one would install larger units if they were not going to cost less than smaller units. In the water-cooled type the curves did not flatten out until well after 20,000 k.v.a. The authors referred to the Manchester-Salford inter-linked system as having the highest working voltage. In that district there was an installation of 30,000 volts connecting up two large power schemes across a distance of 10 miles, and 16,000 kw. and 12,000 kw. running plant. This system was being extended at the present moment, and would finally form a transformer system consisting of three legs, each approximately 10 to 11 miles long, and feeding different sections at 3 or 4 points. In connection with this particular system they had installed at each end the 6,000 kw. forced cooled type. One point not mentioned in connection with forced cooled types was the enormous loss of oil. There was rather a depreciatory tendency as to the reliability of large transformers. His company, however, have not had a single case of failure on large units.

Mr. Carter said that as a colliery engineer he was interested in the conveyance of large transformers filled with oil underground. He considered this would be rather a difficult matter. He was inclined to think that the use of single phase current was the better way of maintaining the supply.

Mr. C. Morley New said the authors had omitted to particularly mention in their comparisons anything regarding the cost, reliability, and the type of connections used on the linking-up scheme. In the particular scheme referred to there were 3-phase transformers at one end and single phase at the other. He thought this was a pretty good start for standardisation. He would be interested to know whether the reactance could be altered on an existing transformer without altering or opening the transformer.

Mr. A. C. Macwhirter referred to the special form of clamping up bolt. He asked what provision the authors made in the core type for allowing the cables or the copper strip to take up their relative positions. He did not think the spring clamping bolt a very sound mechanical job, and much preferred an arrangement which would follow up the windings automatically by a coiled spring.

Mr. Wayne Morgan thought that a little more emphasis might have been laid on the nature of the oil to be used for cooling purposes.

Mr. Ellis, Junr., inquired as to the time which elapsed in connection with the shrinking of the insulation between the punchings.

Mr. A. G. Ellis, in the course of his reply, stated that the designer was often hampered by the conditions in the specification which told him how far he had to go as regards insulation, current density, &c., which precluded the production of a satisfactory article from his point of view. He agreed that crane capacity should not stand in the way of producing the best type of plant. On the question of spares, the comparison of single-phase with three-phase was on the same basis. Mr. Chamen raised the point of periodicity. He hardly thought that controversy should have been raised, as it was not really relative to the paper. Mr. Chamen asked quite rightly whether the spring attachment for taking up the shrinkage in winding had been tested in practice. There were several installations and no trouble so far had been experienced. In connection with the query raised by Mr. Newman as to whether there was any variation in the particulars since the data were compiled, prices had certainly gone up, especially of labour and material. He would give definite figures when replying in the *Journal*. The question of road transport had been considered, but his experience in this connection had not been happy. The question of drying out on site depended entirely upon how long the transformer had been on route and lying about. He considered weather-proof transformers should form the subject for a separate paper. Regarding the annual charges for copper and iron losses, he suggested that all the losses that went through a sub-station were chargeable at the same rate, because the losses, as such, could have very little effect upon the load factor in its entirety. The shrinkage of windings reduced the safety factor—hence the necessity for following up the shrinkage, and this led manufacturers to devising springs for taking up the shrinkage automatically. As regards water and air-cooled transformers, when one got down to 1,000 k.v.a. the water-cooled type was more expensive than the self cooled. Views differed considerably as to single or three-phase transformers, and in the end he considered local conditions were the governing factors. Mr. Carter spoke of transformers for colliery work below the surface. There were quite a large number of designs for this type of work, of particularly robust construction and practically oil tight. The type of connections suitable for transformers required a separate paper. It was very unsound practice to attempt, as some manufacturers did, to obtain high efficiencies by cutting down insulation. The question of oil raised by Mr. Wayne Morgan was a very important one, and a paper which dealt with transformer and switch oils would be very welcome.

The authors reserved their full reply for the I.E.E. *Journal*.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

7,614. "Arc lamps." A. E. Angold. March 15th.

7,661. "Sparking-plug terminal." A. E. Wade. March 15th.

7,663. "Process of melting and reducing metals." E. C. R. Marks (Scovill Manufacturing Co.). March 15th.

7,664. "Electric furnaces." E. C. R. Marks (Scovill Manufacturing Co.). March 15th.

7,699. "Electric fuse-holders." A. H. Maxwell and F. Shergold. March 15th.

7,708. "Apparatus for continuous production of sheet metal, strip and wire." S. O. Cowper-Coles. March 15th.

7,714. "Sparking plugs." R. Breton. March 15th. (France, October 16th, 1919.)

7,732. "Electric accumulators." A. B. Treguany and J. S. Vila. March 15th.

7,737. "Sparking plugs." G. Calvert. March 15th.

7,785. "Vacuum tubes." Western Electric Co. (Western Electric Co.). March 16th.

7,793. "Automatic electrical steering-gear for ships." W. P. Gandell and A. K. Macrorie. March 16th.

7,799. "Railway electric track-circuits." W. R. Sykes Interlocking Signal Co. and R. W. Tarrant. March 16th.

7,801. "Electric resistance." R. A. R. Bolton. March 16th.

7,804. "Electric fires." E. C. R. Marks (Reed). March 16th.

7,809. "Gas-filled electric glow-lamp." Siemens & Halske Akt. Ges. March 16th. (Germany, September 20th, 1913.)

7,815. "Electric generating devices." A. Barre. March 16th.

7,824. "Magneto-electric machines." British Thomson-Houston Co. & A. P. Young. March 16th.

7,831. "Electric switches." Igranic Electric Co. (Cutler Hammer Manufacturing Co.). March 16th.

7,838. "Dynamo-electric machines, particularly motors for use in mines." G. W. Walton. March 16th.

7,849. "Wireless reception." H. Morris-Airey, S. H. Long and A. K. Macrorie. March 16th.

7,850. "Reception in wireless telegraphy, particularly in direction-finding." H. Morris-Airey, S. H. Long and A. K. Macrorie. March 16th.

7,851. "Wireless transmitting circuits employing thermionic valves." H. Morris-Airey, A. K. Macrorie, R. L. Randall and G. Shearing. March 16th.

7,867. "Electric light distribution devices." C. G. Smith. March 17th.

7,872. "Power-factor calculator for use with idle-current meters in alternating-current electricity systems." W. Hutchison. March 17th.

7,887. "Means for supporting arc lamps." A. E. Angold. March 17th.

7,911. "Condensing steam-electric locomotive." D. M. Ramsay and J. W. Wood. March 17th.

7,914. "Terminal." I. Naster. March 17th.

7,925. "Dynamo-electric machines." T. L. R. Cooper. March 17th.

7,932. "Combined electric motor and compressors or pumps." F. Angell and H. B. Angell. March 17th.

7,941. "Reflectors for electric lamps." J. F. Fletcher and J. H. Jones. March 17th.

7,943. "Systems of electric ship propulsion." British Thomson-Houston Co. and F. H. Clough. March 17th.

7,944. "Protecting compositions." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 17th.

7,945. "Electric motor control." J. F. Tritle. March 17th. (United States, June 6th, 1919.)

7,973. "Electrical apparatus for medical purposes." H. J. Monson. March 17th.

8,015. "Electric incandescent or glow lamp holders." R. T. Norton. March 18th.

8,026. "Electric lamp holders." British L.M. Ericsson Manufacturing Co., A. A. Godfrey and H. H. Hayes. March 18th.

8,062. "Electro-magnetic step-by-step mechanism." C. L. Walker. March 18th.

8,063. "Apparatus for electrically controlling railway trains, &c., through the track." A. R. Angus. March 18th. (Sweden, October 16th, 1917.)

8,065. "Electric storage batteries." R. E. Beswick. March 18th.

8,073. "Continuous-current dynamo or motor." J. E. Jones. March 18th.

8,081. "Oscillation generators." Western Electric Co. March 18th. (United States, June 4th, 1917.)

8,083. "Means of changing poles of four-phase windings." Siemens Schuckertwerke. March 18th. (Germany, June 30th, 1917.)

8,084. "Three-phase machines." Siemens Schuckertwerke. March 18th. (Germany, April 23rd, 1918.)

8,102. "Process for manufacture of wire." S. O. Cowper-Coles. March 18th.

8,114. "Electric candle lamps." C. A. Damey. March 18th.

8,118. "Device for lubricating bearing of distributor shaft of ignition apparatus for internal-combustion engines." R. Bosch Akt. Ges. March 18th. (Germany, May 10th, 1919.)

8,120. "Electric switch." W. F. Boddington. March 18th.

8,132. "Inner and outer electrodes of sparking plugs." E. F. Burrill, S. E. Grubb and T. E. Nankivell. March 18th.

8,144. "Operating generating stations in parallel." A. M. Taylor. March 19th.

8,147. "Medical galvanic battery." L. O. Simmons and B. B. H. Sumner. March 19th.

8,160. "Electrical heating elements." H. H. Cressall and The Cressall Manufacturing Co. March 19th.

8,170. "High-tension magnetos." J. Guardiola. March 19th. (France, January 16th, 1919.)

8,174. "Electric meters for alternating currents." Azienda Elettrica Municipale. March 19th. (Italy, March 26th, 1919.)

8,177. "Radio-navigational apparatus, &c." J. Erskine-Murray and J. Robinson. March 19th.

8,200. "Wireless transmitting and receiving apparatus." L. J. Price. March 19th.

8,215. "Utilising sound vibrations." H. Fairbrother (Wireless Spitzescope Co.). March 19th.

8,234. "X-ray tube." Siemens & Halske Akt. Ges. March 19th. (Germany, June 22nd, 1918.)

8,244. "Electric motors for starting internal-combustion engines." R. Bosch Akt. Ges. March 19th. (Germany, May 5th, 1919.)

8,245. "Transformers." Western Electric Co. March 19th. (United States, November 15th, 1917.)

8,249. "Electron discharge devices." General Electric Co. and B. S. Gossling. March 19th.

8,262. "Terminal fittings for electrical devices." P. R. Cartwright and E. V. Sims. March 19th.

8,316. "Spark plugs." O. F. Stahl. March 20th.

8,341. "Telephone systems." Automatic Telephone Manufacturing Co. March 20th. (United States, June 30th, 1919.)

8,353. "Magneto-electric machines." L. N. Reddie (Camillo Olivetti & Co.). March 20th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

8,964. Electric cables or conductors. T. S. Seymour and St. Helens Cable & Rubber Co. June 22nd, 1917. (Cognate application 11,528 of 1917.) (139,226.)

1918.

15,603. System for the instantaneous and electrical heating of water. L. E. Seimbille. September 28th, 1917. (119,474.)

19,670. Prepayment devices. British Thomson-Houston Co. (General Electric Co., U.S.A.). November 28th, 1918. (139,240.)

20,459. Telegraphic systems. E. Frattola, V. E. Castelli and R. R. Regnoni. December 9th, 1918. (139,241.)

21,633. Method of electric welding. T. E. Murray. February 6th, 1918. (123,060.)

1919.

1,598. Electric telegraphs. W. H. Roberts and F. J. Matson. January 22nd, 1919. (139,259.)

2,194. Charging-boards for electric accumulators. H. Leitner and W. H. Exley. January 29th, 1919. (139,264.)

2,203. Electric dry batteries. J. G. Hossack. January 29th, 1919. (139,265.)

3,434. Electric motors for operating pumps and for other purposes. C. H. Reid. February 12th, 1919. (139,277.)

3,883. Electric and gas ovens, stoves, and like appliances. H. H. Berry. February 17th, 1919. (139,285.)

4,472. Mono-polar electrode electrolysers. G. G. Hepburn. February 22nd, 1919. (139,296.)

5,736. Electric printing telegraph machines. Western Electric Co. (Western Electric Co.). March 7th, 1919. (139,306.)

16,024. Grids for the plates of electric storage batteries. Van Raden & Co. and H. C. Smith. June 25th, 1919. (139,388.)

20,506. Electric couplings. E. H. Fuller & Ross, Courtney & Co. August 20th, 1919. (139,416.)

20,885. Electric alarm or door security devices. K. Krone. August 25th, 1919. (139,418.)

24,214. Sound-reproducers for gramophones and telephones. Resonance, Ltd., R. A. Dibden and G. H. Glover. October 3rd, 1919. (139,431.

24,738. Electrical apparatus for operating railway signals. Soc. d'Electricite Mors. October 4th, 1918. (133,703.)

27,265. Means of fastening a cover on a magneto frame. Soc. des Moteurs Salmson. September 10th, 1919. (139,440.)

Modern Lighting Methods in Small Houses.—That modern scientific methods of illumination are just as necessary and beneficial in the small house as they are in the largest interiors is an obvious truism to any lighting engineer. In many cases, however, the owners of ordinary suburban houses appear to be under the impression that the many new kinds of indirect and semi-indirect equipment, which have been developed during recent years, are for some reason not suitable for their small rooms. As a matter of fact, the very opposite of this is true, because it *is* in small rooms with comparatively low ceilings that the glare and bad distribution from bare or improperly shaded lamps is most pronounced, since it is impossible in such situations to place the lamps outside the normal range of vision, and equally impossible, as a rule, for several occupants to arrange themselves so that each secures a good reading light, free from shadows. The illuminating engineering department of the British Thomson-Houston Co., Ltd., points out that an electrical contractor who cares to carry out a simple demonstration should have no difficulty in convincing the average householder of the advantages of indirect and semi-indirect lighting for the illumination of small and moderate-sized living rooms. For example, in a sitting-room lighted by a central arm fitting equipped with, say, three 40-watt lamps in ordinary ornamental glass shades, the contractor could substitute temporarily, for demonstration purposes, a small semi-indirect fitting with a Veluria or Druid white glass bowl containing a single 60- or 100-watt Mazda half-watt lamp.

It will at once be apparent that, even with this reduced wattage, the lighting results are vastly improved. The intensity of illumination will be a great deal more uniform, the diffusion will be infinitely better, and it will be found possible to read comfortably in any part of the room, and in any position relative to the light source. In addition, there will be no glare, because the brilliant lamp is completely screened by the diffusing bowl of the fittings. Totally indirect lighting on the B.T.H. "Eye-rest" system is also admirably suited to the illumination of small living rooms, and the characteristics of good diffusion and absence of glare are even more pronounced than with semi-indirect lighting. An "Eye-rest" fitting can be temporarily rigged up in a very short time, and the illumination results are bound to make a strong impression upon anyone who has not previously had experience of this method of lighting.

Such a demonstration as this could be carried out very quickly. The substitution of one fitting for another should not take more than 10 minutes or so, and in all likelihood the contractor will not be asked to put the old fitting back.